PB-230 611

POLLUTION OF THE NAVIGABLE WATERS OF PUGET SOUND, THE STRAIT OF JUAN DE FUCA AND THEIR TRIBUTARIES AND ESTUARIES., WASHINGTON. PROCEEDINGS OF CONFERENCE SESSION (2ND) HELD AT SEATTLE, WASHINGTON ON SEPTEMBER 6-7 AND OCTOBER 6, 1967. VOLUME I

Federal Water Pollution Control Administration
Washington, D.C.

1967

DISTRIBUTED BY:

NTIS
National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 230 611

CONFERENCE
ON THE
MATTER OF POLLUTION OF THE NAVIGABLE WATERS OF PUGET SOUND, THE STRAIT OF JUAN DE FUCA AND THEIR TRIBUTARIES AND ESTUARIES (WASHINGTON)

held in

Seattle, Washington
September 6-7, 1967
and
October 6, 1967

TRANSCRIPT OF PROCEEDINGS

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

Federal Water Pollution Control Administration
U. S. Department of the Interior
Washington, D. C.

241

CONTENTS

PAGE

September 6, 1967

OPENING STATEMENT
by Murray Stein 24

FEDERAL PRESENTATION:

Richard F. Poston 34

Earl N. Kari .... 34 and 106

John Vlastelicia .... 39 and 82

Marvin Allum 53

John Glude 113

Fred Overly 125

William J. Beck 129

Norman J. MacDonald 131

Department of Commerce and Economic Development.... 423

STATE PRESENTATION:

Roy M. Harris 134

James C. Plunter 145

John Douglas 146

J. E. Lasater 149

Robert O. Sylvester (Personal Statement).......... 158

James E. Phillips 164

Philip H. Parker 170

CONTENTS (CONTINUED)

PAGE

PULP & PAPER INDUSTRY PRESENTATION:

Donald J. Benson 177
Joseph McCarthy 193
Eugene P. Haydu 205
Thomas Saunders English 217

September 7, 1967

PULP & PAPER INDUSTRY PRESENTATION (continued):

Charles S. Yentsch 227
Dr. Ernest O. Salo 244
Dr. Max Katz 258
Murl Miller 327
Robert I. Thieme 337
J. O. Julson 356
John H. Dunkak 360
E. J. Cavanaugh 368
Roger Tollefson 376
Dr. Herman Amberg 393

SHELLFISH INDUSTRY PRESENTATION:

Edward J. Gruble 281
Bob O. Bower 296
R. N. Steele 312
R. H. Bailey 314

CONTENTS (CONTINUED)

PAGE

INDIVIDUAL STATEMENTS:

Northwest Fisheries Association 397
Tacoma Sportsmen's Club 399
Lake Whatcom Improvement Committee 413

October 6, 1967

OPENING STATEMENT
by Murray Stein 430

SUPPLEMENTAL PRESENTATIONS:

Fibreboard Corporation 431
Weyerhaeuser Company 444
Halibut Fishermen's Wives' Association............ 451
Association of Western Pulp and Paper Workers 452
State of Washington Department of Fisheries 459
Congress of American Fishermen 584
League of Women Voters, Bellingham, Washington ... 586

JOINT STATEMENT OF THE FEDERAL AND STATE CONFEREES:
by Mr. Harris 589

SUMMARY
by Mr. Stein 598

- - -

INDEX TO EXHIBITS

PAGE

1 - Joint Federal-State Study, "Pollutional Effects of Pulp and Paper Mill Wastes in Puget Sound," dated March 1967 36

2 - Slides presented by Marvin Allum 57

3 - Mount Vernon and Port Angeles, Washington, Water Quality Standard hearings 188

4 - Investigations of Pearl-Benson method, published in TAPPI magazine 194

5 - Two reports prepared by Dr. Max Katz for the Northwest Pulp and Paper Association 264

6 - Movie shown by Edward J. Gruble 281

7 - Report entitled "Port Angeles Water Quality Monitoring Program," by Stein and Denison, introduced by Roger Tollefson 378

8 - Petitions presented by Ellis Ogilvie, citizen 411

9 - Statement and appended exhibits presented by Lake Whatcom Improvement Committee 422a

- - -

CONTENTS (CONTINUED)

PAGE

INSERTS:

Summary of Marvin Allum Statement 53a

Chart of Puget Sound - General Study Area 85a

Table - Index of Average Covered Employment in Clallam County 170a

Paper - "The Oyster Producing Potential of Puget Sound" by Ronald E. Westley 174

Slides presented by Dr. Max Katz 280a

Aerial photographs of the North Sound area .... 315a and 315b

Chart of cost-benefit relationship in the Delaware River complex 341a

Statement of John B. Gray, offered by Roger Tollefson 378

Statement of Storrs Waterman, offered by Roger Tollefson 378i

Progress Report No. 1 of the Technical Coordinating Committee considering Pollution of Waters of Puget Sound, Strait of Juan de Fuca, and their Tributaries and Estuaries, presented by Tacoma Sportsmen's Club 401a

Article - "Polluters Hidden Victory" - in Argus magazine March 1967, presented by Tacoma Sportsmen's Club .... 407a and 407b

Full statement by Lake Whatcom Improvement Comm.... 422b to 422n

Fibreboard Corporation Exhibit A 435
" " " B 438
" " " C 438
" " " D 439

CONTENTS (CONTINUED)

INSERTS (continued):

PAGE

Weyerhaeuser Company Attachment 447

State of Washington Department of Fisheries
Exhibit A 459
Exhibit B 465
Exhibit C 467
Exhibit D 477
Exhibit E 513
Exhibit F 551
Exhibit G 584a
Exhibit H 584k

- - -

CONFERENCE

The Conference in the Matter of Pollution of the Navigable Waters of Puget Sound, the Strait of Juan de Fuca, and their Tributaries and Estuaries within the State of Washington, convened at 9:30 a.m., Wednesday, September 6, 1967, at The Olympic Hotel, 4th and Seneca Streets, Seattle, Washington.

CONFEREES:

Presiding:

Murray Stein
Assistant Commissioner for Enforcement
Federal Water Pollution Control Administration
Department of the Interior
Washington, D. C.

State Conferee:

Roy M. Harris
Director
State Water Pollution Control Commission
Olympia, Washington

Federal Conferee:

Richard F. Poston
Regional Director
Pacific Northwest Region
Federal Water Pollution Control Administration
Portland, Oregon

PARTICIPANTS:

FEDERAL PRESENTATION

Marvin O. Allum
Water Quality Standards Coordinator
Pacific Northwest Region
Federal Water Pollution Control Administration
Portland, Oregon

Earl N. Kari
Acting Director, Technical Programs
Pacific Northwest Region
Federal Water Pollution Control Administration
Portland, Oregon

John Vlastelicia
Acting Chief, Technical Operations Branch
Pacific Northwest Region
Federal Water Pollution Control Administration
Portland, Oregon

John B. Glude
Deputy Regional Director
Pacific Northwest Region
U. S. Bureau of Commercial Fisheries
Seattle, Washington

William J. Beck
Chief, Shellfish Sanitation Laboratory
Public Health Service
Gig Harbor, Washington

Norman J. MacDonald
Chief, Water Control
Corps of Engineers, Seattle District
Seattle, Washington

Fred J. Overly
Regional Director, Pacific Northwest Region
Bureau of outdoor Recreation
Seattle, Washington

PARTICIPANTS (continued):

STATE PRESENTATION

John H. Douglas
Fisheries Biologist
Washington Game Department
Olympia, Washington

J. E. Lasater
Assistant Director of Research
Washington Department of Fisheries
Olympia, Washington

Philip H. Parker
Executive Secretary
Pacific Coast Oyster Growers Association
Olympia, Washington

James E. Phillips
President
Port Angeles Chamber of Commerce
Port Angeles, Washington

James C. Plunter
Head, Sanitary Engineering Section
Washington State Department of Health
Olympia, Washington

PULP & PAPER INDUSTRY PRESENTATION

Herman Amberg
Manager, Manufacturing Services
Crown Zellerbach Corporation
Camas, Washington

Donald J. Benson
Executive Secretary
Northwest Pulp & Paper Association
Seattle, Washington

E. J. Cavanaugh
Plant Manager
Fibreboard Paper Products Corporation
Port Angeles, Washington

John Dunkak
General Manager, Puget Sound Division
Georgia-Pacific Corporation
Bellingham, Washington

PARTICIPANTS (continued):

PULP & PAPER INDUSTRY PRESENTATION (continued)

Thomas Saunders English
Associate Professor, Department of Oceanography
University of Washington
Everett Mills Technical Council
Everett, Washington

Eugene P. Haydu
Biologist, Pulp Research Department
Weyerhaeuser Company
Kalama, Washington

J. O. Julson
Director, Air Water Resources
Weyerhaeuser Company
Tacoma, Washington

Max Katz
Research Associate Professor
Department of Fisheries
University of Washington
Seattle, Washington

Joseph L. McCarthy
Professor, Pulp Mills Research
University of Washington
Seattle, Washington

A. Murl Miller
Senior Process Engineer
Scott Paper Company
Everett, Washington

Ernest O. Salo
Associate Professor, College of Fisheries
Fisheries Research Institute
University of Washington
Seattle, Washington

Robert I. Thieme
Vice-President, General Manager
West Coast Division
Scott Paper Company
Everett, Washington

PARTICIPANTS (continued):

PULP & PAPER INDUSTRY PRESENTATION (continued)

Roger Tollefson
Research Supervisor
Olympia Research Division
Rayonier Incorporated
Shelton, Washington

Charles S. Yentsch
Biological Oceanographer
Research Associate
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

SHELLFISH INDUSTRY PRESENTATION

R. H. Bailey
Managing Director
Citizens for Clean Waters
Seattle, Washington

Bob O. Bower
President
Pacific Coast Oyster Growers Association
Olympia, Washington

Edward J. Gruble
President
Oyster Institute of North America
Seattle, Washington

R. N. Steele
Owner
Rock Point Oyster Company
Blanchard, Washington

INDIVIDUAL PARTICIPANTS

William J. Dittrich
Lake Whatcom Improvement Committee
Bellingham, Washington

Dr. B. J. Gilshannon
Chairman, Executive Committee
Lake Whatcom Improvement Committee
Bellingham, Washington

PARTICIPANTS (continued):

INDIVIDUAL PARTICIPANTS (continued)

Robert O. Sylvester
Professor of Sanitary Engineering
University of Washington
Department of Civil Engineering
Seattle, Washington

- - - -

OTHERS IN ATTENDANCE:

Fred Aldridge
Director of Environmental Health
Seattle King County Department of Public Health
Seattle, Washington

G. C. Anderson
Associate Professor, Oceanography
University of Washington
Seattle, Washington

E. W. Asselstine
Senior Engineer
State Water Pollution Control Commission
Olympia, Washington

Roy A. Banner
Assistant Chief
Fish Management Director
Department of Game
Olympia, Washington

A. F. Bartsch
Assistant Chief, Eutrophication Research
Pacific Northwest Water Laboratory
Federal Water Pollution Control Administration
Corvallis, Oregon

D. J. Baumgartner
Acting Chief, Coastal Pollution Research
Pacific Northwest Water Laboratory
Federal Water Pollution Control Administration
Corvallis, Oregon

Richard M. Beebe
Manager, Industrial Division
Washington State Department of Commerce
Olympia, Washington

OTHERS IN ATTENDANCE (continued):

James P. Behlke
Chief, Division of Engineering
Water Pollution Control Commission
Olympia, Washington

Harold Berkson
Executive Secretary, NTAC
Federal Water Pollution Control Administration
Washington, D. C.

Donald E. Bevan
Associate Dean
College of Fisheries, University of Washington
Seattle, Washington

Jeffrey Birch
Programmer
KO Incorporated
Seattle, Washington

Wilson F. Bow
Supervising Engineer
Washington State Health
Seattle, Washington

Betty Branostrom
Delegate
Purse Seine Wives
Mukilteo, Washington

Ed Brezina
Vice Chairman, Pollution Control Committee
Tacoma Sportsmen's Club
Tacoma, Washington

P. R. Burnaman
Assistant to General Manager
Scott Paper Company
Everett, Washington

Edward Button
Technical Department Superintendent
Rayonier Incorporated
Hoquiam, Washington

Dale A. Carlson
Professor of Civil Engineering
University of Washington
Seattle, Washington

OTHERS IN ATTENDANCE (continued):

Jo Ann Christensen
Federal Water Pollution Control Administration
Portland, Oregon

Dwayne J. Clark
Technical Director
Simpson Lee Paper Company
Everett, Washington

Thomas O. Clemetson
Senior Chemist
Water Pollution Control Commission
Olympia, Washington

Larry Coffman
Reporter
Seattle Times
Seattle, Washington

James C. Cooper
Chief Chemist
West Tacoma Newsprint
Steilacoom, Washington

John Denison
Group Leader, Environment Control Section
Rayonier Incorporated
Hoodsport, Washington

William Devine
Director, Production Reactors
U. S. Atomic Energy Commission
Richland, Washington

L. B. Dezarn, LTC
Deputy District Engineer
U. S. Army Engineer District, Seattle
Seattle, Washington

Charles C. Dills
Environmental Engineer
Leo A. Daly Company
Seattle, Washington

Emerson Elder
Public Relations Manager
Weyerhaeuser Company
Everett, Washington

OTHERS IN ATTENDANCE (continued):

Joe Entrikin
Manager, Whatcom County Development Council
Bellingham, Washington

J. Allan Evans
Assistant Secretary
Georgia-Pacific Corporation
Bellingham, Washington

Glen Farris
Superintendent of Water Quality
Municipality of Metropolitan Seattle
Seattle, Washington

John Girard
Ad. Sanitarian
Washington State Health Department
Olympia, Washington

Rod Gjerde
Public Affairs Manager
Weyerhaeuser Company
Tacoma, Washington

Albert C. Gribos
Technical Director
Weyerhaeuser Company
Everett Sulphite Mill
Everett, Washington

Matthew Gould
Director, Environmental Control
Georgia-Pacific Corporation
Portland, Oregon

Donna Granberg
President, Purse Seine Wives
Edmonds, Washington

Keith Grim
Lawyer
Georgia-Pacific Corporation
Seattle, Washington

Glen F. Hallman
Director, Environmental Health
Bellingham-Whatcom County District Health Department
Bellingham, Washington

OTHERS IN ATTENDANCE (continued):

George H. Hansen
Chief, Technical Services Division
Water Pollution Control Commission
Olympia, Washington

Jerry L. Harper
Water Pollution Control Commission
Olympia, Washington

Dwight S. Hawley
State Representative
CHM-Fisheries Interim Committee
Seattle, Washington

Gilbert L. Heath
Assistant Plant Manager
Scott Paper Company
Everett, Washington

Frank Hodgson
President
KO Incorporated
Seattle, Washington

Lewis R. Holcomb
Administrative Assistant
Water Pollution Control Commission
Olympia, Washington

Gary W. Isaac
Renton Division Superintendent
Municipality of Metropolitan Seattle
Seattle, Washington

Emil C. Jensen
Deputy Director for Environment
Washington State Health Department
Olympia, Washington

Eugene Jensen
Office of Estuarine Study
Federal Water Pollution Control Administration
Washington, D. C.

Mrs. Eugene Jensen
private citizen
Tacoma, Washington

OTHERS IN ATTENDANCE (continued):

Bryan Johnson
Federal Water Pollution Control Administration
Portland, Oregon

John F. Ketter
Public Affairs Representative
Weyerhaeuser Company
Federal Way, Washington

F. W. Kittrell
Acting Chief, TA&I
Federal Water Pollution Control Administration
Cincinnati, Ohio

L. B. Laird
District Chief
U. S. Geological Survey
Tacoma, Washington

Nicholas Lardieri
Manager, Air & Water Resources
Scott Paper Company
Philadelphia, Pennsylvania

Robert E. Leaver
Planning Engineer
State Health Department
Seattle, Washington

E. H. Lemier
Senior Biologist
Washington Department of Fisheries
Olympia, Washington

Richard C. Lofgren
Executive Engineer
R. W. Beck and Associates
Seattle, Washington

Oliver Malm
Lawyer
Weyerhaeuser Company
Tacoma, Washington

Brian W. Mar
Resident Associate Professor
University of Washington
Seattle, Washington

OTHERS IN ATTENDANCE (continued):

Stephen G. Martin
Resident Biologist
Rayonier Incorporated, Olympia Research Division
Shelton, Washington

Robert K. McCormick
Regional Engineer
Water Pollution Control Commission
Olympia, Washington

Ray McMackin
Radio News
KIRO

Robert L. McNeil
U. S. Bureau of Outdoor Recreation
Seattle, Washington

John R. Molsness
District Engineer
State Health Department
Seattle, Washington

David L. Mosher
Technical Superintendent
Fibreboard Paper Products
Port Angeles, Washington

Mrs. Peter Mosness
Trustee, Puget Sound Gillnetters
Association Auxiliary
Seattle, Washington

Mrs. Peter Mosness
Corresponding Secretary
National Fishermen & Wives, Incorporated
Seattle, Washington

D. A. Nadig
Mill Manager, Port Angeles Division
Crown Zellerbach Corporation
Port Angeles, Washington

Leo E. Nagan
District Manager
Nalco Chemical Company
Mercer Island, Washington

OTHERS IN ATTENDANCE (continued):

Alfred T. Neale
Assistant Director
Water Pollution Control Commission
Olympia, Washington

Anthony Nouotny
Fisheries Research Biologist
U. S. Bureau of Commercial Fisheries
Seattle, Washington

Ellis H. Ogilvie
Seattle, Washington

Erling J. Ordal
Professor of Microbiology
University of Washington
Seattle, Washington

DeForest Perkins
Attorney
Rayonier Incorporated
Seattle, Washington

Rheta Piere
Federal Water Pollution Control Administration
Washington, D. C.

Roland E. Pine
Section Head, Surveillance & Investigation
Water Pollution Control Commission
Olympia, Washington

Charles R. Pollock
Northwest Fisheries
Seattle, Washington

T. Rajda
Federal Water Pollution Control Administration
Washington, D. C.

Harold Randles
Technical Superintendent
St. Regis Paper Company
Tacoma, Washington

Francis J. Reyes
Federal Water Pollution Control Administration
Portland, Oregon

OTHERS IN ATTENDANCE (continued):

W. Ronald Richardson
Resident Manager
Crown Zellerbach Corporation
Seattle, Washington

Teri LaRocque
Clinton, Washington

Charles B. Roe
Assistant Attorney General
State of Washington
Olympia, Washington

Otto H. Sangder
Effluent Control Supervisor
Rayonier Incorporated, Grays Harbor Division
Hoquiam, Washington

Albert J. Scholz
Biologist
Washington Department of Fisheries
Quilcene, Washington

H. V. Schubert
Fuel Engineer
Bethlehem Steel Corporation
Seattle, Washington

Ralph H. Scott
Acting Chief, Ind. Waste Treatment
Federal Water Pollution Control Administration
Northwest Water Laboratory
Corvallis, Oregon

Herbert E. Simison
Federal Water Pollution Control Administration
Portland, Oregon

Elizabeth Smith
Everett, Washington

LeRoy E. Smith
Technical Supervisor
Weyerhaeuser Company
Everett, Washington

OTHERS IN ATTENDANCE (continued):

George Snyder
Fisheries Research Biologist
B.C.F.
Seattle, Washington

Robert William Steele
President
Seattle Marine Laboratories
Seattle, Washington

Claude M. Stitt
Manager,Water Resources
Fibreboard Corporation
Antioch, California

Robert L. Stockman
Executive Director
Washington State Air Pollution Control Board
Seattle, Washington

John R. Swanson
Area Representative
Association of Western Pulp and Paper Workers
Portland, Oregon

Paul H. Symbol
Assistant Public Affairs Officer
Hill, Ingman, Chase & Company,
Consulting Engineers
Seattle, Washington

Marvin Tarr
Chemist
State Department of Fisheries
Brinnon, Washington

Bruce H. Taylor
Oceanographer
KO Incorporated
Seattle, Washington

Michael W. Tiernan
Health Physicist
United States Atomic Energy Commission
Richland, Washington

OTHERS IN ATTENDANCE (continued):

Georgette Valle
Seattle, Washington

Paul Vergets
Attorney
Crown Zellerbach Corporation
Portland, Oregon

Richard A. Wagner
Federal Water Pollution Control Administration
Portland, Oregon

R. E. Westley
Biologist
Washington Department of Fish
Shellfish Laboratory
Brinnon, Washington

Cecil M. Whitmore
Water Quality Analyst
Municipality of Metropolitan Seattle
Seattle, Washington

L. M. Whitmore, Jr.
Engineer
Puget Sound Air Pollution Agency
Mukilteo, Washington

Charles E. Woelke
Biologist
University of Washington
Seattle, Washington

Grant A. Woolley
Biologist
Bureau of Sport Fisheries & Wildlife
Portland, Oregon

Dick Young
Reporter
The Everett Herald
Everett, Washington

- - - -

PROCEEDINGS

OPENING STATEMENT

BY

MR. MURRAY STEIN

CHAIRMAN STEIN: The Conference is open.

This session of the Conference in the matter of pollution of the navigable waters of the Puget Sound, the Strait of Juan de Fuca, and their tributaries and estuaries within the State of Washington is being held under the provisions of Section 10 of the Federal Water Pollution Control Act, as amended. The Secretary of the Interior is authorized to call a Conference of this type when requested to do so by the Governor of a State. The Governor of Washington, Hon. Albert D. Rosellini, requested a Conference on November 22, 1961, and the first session was held January 16 and 17, 1962.

The purpose of the Conference is to bring together representatives of the State Water Pollution Control Agency, representatives of the United States Department of the Interior, and other interested parties, to review the existing situation, the progress which has been made, to lay a basis for future action by all parties concerned, and to give the State, localities and industries an opportunity to take any indicated remedial action under State and local law.

The Conference technique is rather an old one. It is used by many State agencies in the normal conduct of their business in the field of water pollution control. And I have known the operations of the State of Washington for many years. I know Roy Harris and his predecessors have used the Conference technique very effectively themselves in the past.

The Conference system was proposed by the United States Supreme Court as long ago as 1921, in the famous case of New York against New Jersey, involving interstate pollution. I would like to quote briefly from this opinion. This is the court speaking.

"We cannot withhold the suggestion, inspired by the consideration of this case, that the grave problem of sewage disposal by the large and growing population living on the shores of New York Bay is one more readily to be most wisely solved by cooperative study and by conference and by mutual concession on the part of representatives of the States so vitally interested in it than by proceedings in any court however constituted."

I think our situation in Puget Sound

probably indicates how prophetic that court was. We have had, not involving the Federal Government fortunately, court cases, and I don't know that that solved the problem. We do have a cooperative study program which is nearing completion and has been completed now. I hope this will be the fruitful way of getting at the problem, as the Supreme Court saw as far back as more than 45 years ago.

We strongly support the conference technique and we measure our success by the problems which are solved at the conference table rather than in court.

As specified in Section 10 of the Federal Water Pollution Control Act, the official water pollution control agency of Washington has been notified of this Conference. Washington is being represented by Mr. Roy Harris, of the Washington State Pollution Control Commission.

The Federal Conferee is Mr. Richard Poston, of the Pacific Northwest Region of the Federal Water Pollution Control Administration, United States Department of the Interior.

My name is Murray Stein. I am from Headquarters of the Federal Water Pollution Control Administration in Washington, D.C., and the representative of Secretary Udall.

The parties to this Conference are the representatives of the official State water pollution control agency and the United States Department of the Interior. Participation in the Conference will be open to representatives and invitees of these agencies and such persons as inform me that they wish to present statements. However, only the representatives of the Washington State Pollution Control Commission and the United States Department of the Interior constitute the Conferees.

I think in this case, with the amicable relations that we have had with the State of Washington, that anyone who believes he should make a statement--other than representatives of Federal agencies, that is--industries, citizens, representatives of groups in the State of Washington, should get in touch with Mr. Harris at the first recess, and I am sure he will arrange for his participation in the Conference.

Both the State and Federal governments have responsibilities in dealing with water pollution control problems. The Federal Water Pollution Control Act declares that the States have primary rights and responsibilities for taking action to abate and control pollution. Consistent with this, we are charged by law to encourage the States in these activities.

At the same time, the Secretary of the

Interior is charged by law with specific responsibilities in the field of water pollution control in connection with pollution of interstate and navigable waters. The Federal Water Pollution Control Act provides that pollution of interstate or navigable waters, whether the matter causing or contributing to the pollution is discharged directly into such waters or reaches such waters after discharge into a tributary, which endangers the health or welfare of any person shall be subject to abatement.

At the first session of this Conference held January 16 and 17, 1962, the Conferees agreed, among other things, that the State of Washington and the Federal water pollution control authorities would develop a joint program to carry out investigations and studies in the Conference area. As a result, the Washington State Enforcement Project was established to carry out the necessary studies. The joint Federal-State studies were carried out over a four-year period, and the project has prepared a comprehensive report of their findings entitled "Pollutional Effects of Pulp and Paper Mill Wastes in Puget Sound". This report has been submitted to the Conferees. This Conference has been reconvened for the purpose of considering a program of remedial action and a time schedule for pollution abatement in the Puget Sound area if such should be appropriate after we have heard all the comments from other interested parties on the investigator's report.

As far as pollution control is concerned, we might point out that the Puget Sound area has now undergone as intensive a study as almost any body of water in the country. We have had an opportunity to think about the issues for many years and investigate all the avenues of approach very thoroughly. I do think generally in the field of water pollution control, particularly concerning the type of wastes with which we are dealing here and the water resource available, that all parties concerned are very sophisticated in this field. As representatives of the Federal Government, the State, the industries involved including the pulp and paper industry, the shellfish growers, the fishing industry, the citizens groups, we have all had an opportunity to think about the problem, with its attendant implications, and should have the issues relatively narrowed.

I also think we must look for areas of agreement. I am pleased to see so many old friends in the audience. Since through thick and thin we have been old friends, I am sure we will find those areas of agreement and remain old friends. The fact that there are so many familiar faces out there indicates that we have gone over these problems over and over and over again, and hopefully this is the forum where we should be able to achieve a large measure of understanding among all the parties.

Now a word about the procedures governing the conduct of the Conference. The Conferees will be called upon to make statements. The Conferees in addition may call upon participants they have invited to the Conference to make statements. In addition, we will call on other interested individuals who wish to present statements. At the conclusion of each statement the Conferees will be given an opportunity to comment or ask questions and I may ask a question or two. This procedure has proven effective in the past in reaching equitable solutions.

At the end of all the statements, we will have a discussion among the Conferees and try to arrive at a basis of agreement on the facts of the situation. The Conferees, in fact, if it is appropriate, may go into executive session. Then we will attempt to summarize the Conference orally, giving the Conferees, of course, the right to amend or to modify the summary.

Under the Federal law, the Secretary of the Interior is required at the conclusion of the Conference to prepare a summary of it, which will be sent to the

Conferees. The Secretary is also required to make recommendations for remedial action if such recommendations are indicated.

A record and verbatim transcript of the Conference is being made by Mrs. Virginia Rankin. This is for the purpose of aiding us in preparing a summary and also providing a complete record of what is said here. We will make copies of the summary and transcript available to the Washington State Pollution Control Commission.

I should indicate that Mrs. Rankin, who has worked with us many times in the past--and if she wasn't so young I would tell you how many years we have worked together--is an independent contractor who got this contract for this Conference by bidding against other court reporters. We have found that the transcript made available to you will be printed and distributed generally in about four months, taking into account the vagaries and problems of Government processing for printing. Now, if any of you should want a copy of the transcript in advance for your own use or any portion of it, I would suggest that you get in touch with Mrs. Rankin and make your own arrangements. I suspect her fees will be as reasonable to you as they are to us.

However, for the others, if you wish a copy, for maintaining relationships within the State, those people who wish the summaries and the transcripts should request them through their State agency, that is Mr. Harris in the Washington State Water Pollution Control Commission, rather than come directly to the Federal Government. The reason for this is that when the Conference has been concluded, we would prefer people who are interested in the problem to follow their normal relationships in dealing with the State agency rather than the Federal Government on these matters. This has worked successfully in the past. We will be most happy, as we have done in the past, to make this material available to the State of Washington for distribution.

Roughly the agenda we are going to follow for the Conference is calling on the Federal Government for its presentation first, then we will call on the State of Washington for its presentation, and Mr. Harris will then call the invitees and the people who have indicated to him that they wish to make statements for the State of Washington. Both Mr. Poston and Mr. Harris will manage their own time. We have generally found that we have one recess in the morning, a luncheon break of about an hour and a half, one or so recesses in the afternoon, depending on the nature of the Conference, and we would hope to stop at 5 o'clock.

We are here to hear everyone, but I give you the schedule so you can gauge your own time. Our experience has shown that with a single reporter it becomes cruel and inhuman punishment to extend the hearing much past 5 o'clock. In addition to that, the Conferees and the participants tend to get testy at that time and sometimes say things they regret later. As Mrs. Hough is fond of pointing out, the tireder she gets after 5 o'clock and the more irritable the Conferees and participants get, the faster they talk. So we put an intolerable burden on the stenographer as we get more tired.

I would suggest that all speakers and participants other than the Conferees making statements come to the lectern and identify themselves for the purposes of the record.

Before we call on the Federal Conferee, I believe that Mr. Harris has an introduction.

Mr. Harris.

MR. HARRIS: I should like at this time to introduce Mr. John Moose, one of the members of the Water Pollution Control Commission. John. (Applause)

I would like to mention that additional commissioners will be on hand for this afternoon's session.

CHAIRMAN STEIN: Thank you, Mr. Harris.

At this point we would like to call on Mr. Richard Poston, the Federal Conferee. Mr. Poston.

FEDERAL PRESENTATION

STATEMENT OF RICHARD F. POSTON
OF THE
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

MR. POSTON: Thank you, Mr. Chairman.

At this time I am going to call on Mr. Earl Kari, who on behalf of the Federal Water Pollution Control Administration has conducted the survey which will be discussed here today. In Mr. Kari's presentation he will call on key members of his staff.

At this time, Mr. Kari.

MR. KARI: Mr. Chairman.

CHAIRMAN STEIN: I might point out that it would simplify matters if you have written copies of your statement to let the Conferees and Mrs. Rankin have them. While the order of priority is very clear, if you just have one copy, give it to Mrs. Rankin. If you have more than one, we would appreciate having them.

Mr. Kari.

STATEMENT OF EARL N. KARI
OF THE
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

MR. KARI: Mr. Chairman, Conferees, my name is Earl Kari. I am with the Federal Water Pollution Control Administration in Portland, Oregon.

EARL N. KARI

INTRODUCTION

Today we will summarize the work and findings of the Washington State Enforcement Project. This Project has been the joint undertaking of the Water Pollution Control Commission in Washington and the Federal Water Pollution Control Administration. Its principal objective was the evaluation of the pollutional impact of pulp and paper mill wastes discharged into Puget Sound upon the fishery resources of those waters. The Project's studies extended into four study areas and considered seven different mills, owned by six companies. The field work began in April 1962 and was completed in June of 1966. A complete description of the studies, the results, and the recommendations of the Washington State Enforcement Project has been published in a 450-page report entitled,"Pollutional Effects of Pulp and Paper Mill Wastes in Puget Sound," dated March 1967. The report has already received wide distribution throughout the Puget Sound area, and, Mr. Chairman, I would like to have the report made a part of the record.

CHAIRMAN STEIN: This will be done. I think the report without objection from the Conferees, should be carried as an exhibit or an appendix to the transcript so it will be readily available to those interested in the problem and you won't have to cross reference or run to a library every time you want to look up a point.

(The report is marked Exhibit 1.)

CHAIRMAN STEIN: You may continue.

MR. KARI: Thank you, Mr. Chairman.

The summary to be presented here will be limited, first, to some general background comments to orient the significance and purpose of the study and this Conference; second, a generalized description of the study methods and significant findings; and finally, a discussion of the impact of the waste sources in each of the four major study areas and the Project's recommendations for pollution abatement.

BACKGROUND

Puget Sound is one of Washington's most valuable assets, and its vast expanse of estuarine waters serves a wide variety of uses, contributing to the economy of the State and the well-being of its residents. By definition in the Water Quality Act of 1965, it is a coastal water and subject to Federal as well as State pollution control measures. The Sound is intensively used for recreation, including boating, picnicking, camping, fishing, and swimming. Water transportation, including ocean-going, coastal, and intra-Sound traffic, is an important water use. The scenic beauty of the Sound area is well known and it provides an attractive setting for homes, summer cottages, and the recreational activities. It is an outstanding tourist attraction.

One of its most important uses, however, in both economic and social terms, is the fishery it supports. Waters of Puget Sound are naturally rich and productive and provide a valuable commercial and sport fisheries resource. The resource includes not only a wide variety of fish and shellfish harvested in the fisheries, but also the numerous lesser food chain organisms necessary to sustain these fisheries. From 1950 to 1963, the average annual commercial harvest of fish and shellfish was about 90 million pounds, and the average annual wholesale value in recent years has been more than ten million dollars. An estimated 300,000 sport fishermen use Puget Sound waters and tributaries annually, and, of course, crabs and clams are taken by many recreationists.

The waters of the Sound can also beneficially serve to assimilate the residual wastes from cities and industries to the extent that such discharges do not interfere with other uses. However, the intensively developed and rapidly growing areas of Puget Sound

EARL N. KARI

generate raw and partially treated waste discharges beyond the capacity of portions of the Sound to absorb them without damaging other water uses.

The State of Washington has long been concerned with the mounting pollution in Puget Sound and has expended a great deal of effort in seeking its abatement. Excellent progress was made in that most cities and industries had met the State's requirements for treatment and control of wastes. However, certain major waste sources, principally the seven pulp and paper mills discussed herein, failed to comply with State recommendations. Because of this and because of the damage occurring in the marine environment the Honorable Albert Rosellini, former Governor of the State of Washington, requested Federal enforcement assistance under provisions of the Federal Water Pollution Control Act.

The initial enforcement Conference was convened January 16 and 17, 1962, to receive testimony on the extent of pollution and its causes and to outline abatement action requirements. In two days of hearings the Conference heard statements from the Washington Pollution Control Commission and five other State agencies, two Federal agencies, the oyster growers, the pulp and paper industry, labor unions, sportsmen, and many other interested individuals and groups. The final recommendation of the Conference was for a joint Federal-State investigation of the pollution, particularly the extent of damages to fishery uses, resulting from pulp and paper industry waste discharges. The Washington State Enforcement Project was initiated to comply with this recommendation, and the results of the Project investigation are the subject of this second session of the Conference.

At this time, Mr. Chairman, I would like to introduce Mr. John Vlastelicia, Deputy Project Director, who will now present the findings of the Project.

CHAIRMAN STEIN: Thank you.

STATEMENT OF JOHN VLASTELICIA

OF THE

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

MR. VLASTELICIA: Mr. Chairman, Conferees, ladies and gentlemen.

My name is John Vlastelicia.

THE STUDY

(The following narrative accompanied the showing of slides:)

The Washington State Enforcement Project studied four specific areas in great detail, and these are shown on the slide. The areas were Bellingham, Anacortes, Everett and Port Angeles.

CHAIRMAN STEIN: Just one moment. Is this visible?

(Lights out.)

MR. VLASTELICIA: Can you read that at the back of the room, Brian?

MR. JOHNSON: Yes.

MR. VLASTELICIA: The four study areas were Bellingham, located in the northern section of the study area, Anacortes just below it, Everett south of that, and Port Angeles on the Strait of Juan de Fuca.

The seven principle mills involved were the Georgia-Pacific Corporation mill at Bellingham, the Scott Paper Company at Anacortes, the Scott Paper Company, Simpson Lee Paper Company and Weyerhaeuser Company at Everett, and Fibreboard Paper Products Corporation and Rayonier, Incorporated, at Port Angeles.

Certain aspects of pollution from an eighth mill, the Crown Zellerbach Corporation mill at Port Angeles, were also considered. Other waste sources discharging to the above study areas were also studied, but were found to be insignificant in relation to the pulp and paper mill waste discharges.

Each of these mills discharges large

JOHN VLASTELICIA

volumes of untreated or partially treated pulp and paper mill wastes into Puget Sound. The ultimate impact of these wastes on the marine environment was largely undocumented at the time of the 1962 Conference. The Project's objectives then were these: First of all, to determine the effects of these wastes on water quality and marine life, secondly to delineate their interference with legitimate water uses, and third to determine pollution abatement needs.

In order to accomplish this rather ambitious program, the Project conducted comprehensive studies consisting of four basic elements:

First, a program of economic studies to evaluate some of the values of water uses and water resources germane to the problems of pulp and paper mill pollution.

Secondly, a program of in-plant surveys to describe the pulp and paper mills and to determine the quantity and composition of the wastes that they discharge into the Sound.

Third, a program of oceanographic and related studies to determine the subsequent distribution of these wastes in the Sound and to describe their effect on the receiving waters.

And fourth, a program of biological studies to determine the effects these wastes have on the marine life.

The findings of these studies are discussed in the March 1967 report that has already been entered in the record. Incidentally, copies of this report are available in the offices of the Water Pollution Control Commission and the Federal Water Pollution Control Administration. The scientific results of the oceanographic and the biological studies have the most significant bearing on the Project's recommendations for pollution abatement and these two studies will be the major substance of today's presentation.

The Project in its work considered results of a number of studies conducted in these areas by other State and Federal agencies, by the University of Washington, and by the pulp mills. Only on a few occasions were specific data withheld by the pulp mills.

OCEANOGRAPHIC AND RELATED STUDIES

Oceanographic and related studies were conducted in each of the four study areas, in Bellingham, Anacortes, Everett and Port Angeles. These studies included three elements:

Periodic water sampling surveys to measure the distributions of waste and related water quality in the receiving waters.

Then a program of water circulation studies to relate the observed distributions of waste and water quality to hydraulic features of the area.

And third, bottom sampling surveys to describe the composition and extent of sludge beds.

Now, while each study area represents a separate waste-receiving environment, there are certain oceanographic features which are characteristic to all. One of considerable importance to the eventual distribution of wastes is the near-surface density stratification which persists in varying degrees throughout Puget Sound. Fresh-water land drainage, being less dense than the saline receiving waters of the Sound, stratifies near the surface. The stability of this layer, of this surface layer, inhibits vertical mixing; thus pulp and paper mill wastes, also of lighter density than seawater, are generally distributed near the surface over wide sectors of the study area.

It is these same surface waters in which are found most of the sensitive marine organisms which are most likely to be adversely affected by pulp and paper mill wastes.

Another finding of the waste distribution and water quality studies is this. There are generally two zones of pollution associated with each waste source. The first zone is a zone of acute pollution surrounding each source. It is a localized condition resulting from the discharge of large volumes of pulp and paper mill wastes to shallow and confined dock-front areas. The extent of this zone varies from a few hundred feet to as much as a mile from the source, depending, of course, on the volume and character of the wastes, the method of discharge, and the local water circulation patterns. Within this zone of acute pollution are found high waste concentrations, anaerobic sludge deposits, and a resulting seriously degraded water quality.

Sulfite waste liquor concentrations often exceed 1,000 parts per million. Sulfides and other toxic and odorous gases are produced and released by the decomposing sludge. Result, oxygen concentrations drop below five parts per million in this zone and often approach zero in some areas, pH of the water drops a unit or more to below seven, sometimes to below six, and the receiving waters are generally turbid or highly colored.

Characteristically, very rapid changes in water quality occur within the acute zone, depending on tides, winds and currents. Conditions in this zone kill fish and are toxic to most other marine forms. The development of a substantial portion of the bottom-dwelling community is precluded, and odors and floating and suspended material are aesthetically unacceptable.

Beyond this zone of acute pollution is a second zone, a zone of chronic pollution. It often extends for many miles from the source. In this zone the major pollutional impact of the pulp and paper mill waste discharges is the presence of diluted quantities of sulfite waste liquor, particularly in the critical near surface waters.

The extent of the zone of chronic pollution depends on the quantity and composition of the wastes, the method and depth of discharge, and the general water circulation patterns in the area.

In summary, then, the oceanographic and related studies documented the existence of pulp and paper mill wastes in Puget Sound, both vertically, in the near-surface density stratified layer where sensitive marine life also floats, and horizontally in two zones depicting concentration of wastes and intensity of impact on marine life, that is the two zones/of acute pollution and of chronic pollution.

JOHN VLASTELICIA

BIOLOGICAL STUDIES

To relate the findings of the oceanographic studies to the Project's general objectives, a number of biological studies were conducted. These biological studies demonstrated that sulfite waste liquor, sludge deposits, and the resulting conditions of degraded water quality are harmful to marine life. The damages observed varied from the rapid kill of juvenile salmon in the zone of acute pollution to the relatively subtle but equally damaging effects on oysters reared in the zone of chronic pollution. The biological studies were designed to either measure the reaction of the test organisms to pulp wastes and water quality parameters through field and laboratory bioassay techniques or to determine changes in biologic population characteristics related to waste levels and distance from the waste source.

JUVENILE SALMON STUDIES

One of the most significant biological studies conducted was that involving juvenile salmon. The anadromous fishery of Puget Sound includes the chinook, the silver, the sockeye, pink, and chum species of salmon and the steelhead, sea-run cutthroat and dolly varden species of trout. After spending most of their adult life in saltwater, these fish return to the tributaries to spawn, and after hatching the juveniles of these fish spend varying periods of time in the tributary streams and the near-shore areas of Puget Sound before moving seaward.

The juvenile salmon studies were conducted in three of the study areas, in Bellingham, in Everett and Port Angeles. They consisted of, first, occurrence studies to determine the migration routes and distribution of wild juvenile salmon in each study area. Secondly, field bioassay tests to determine the survival of these fish in waters polluted by pulp and paper mill wastes and insofar as possible to determine what specific water quality parameters it is that does kill the fish that do die.

The occurrence studies made by the Project, along with similar studies made for the pulp mills by the Fisheries Research Institute at the University of Washington, showed that wild juvenile salmon are present in large numbers at certain times of the year in each of the three areas studied, and more importantly that the migration patterns for a significant portion of these fish are through the zones of acute pollution near the mill outfalls.

Field bioassay studies were conducted by placing numbers of juvenile salmon in various arrangements of live boxes and holding tanks throughout the zones of acute pollution. Fish reactions to waste level and water quality were monitored at regular intervals. The parameters measured included sulfite waste liquor, dissolved oxygen, pH, hydrogen sulfide and total sulfides, ammonia, and in some cases residual chlorine.

More than 100 tests were made and hundreds of fish were killed. The results showed that while conditions in the zone of acute pollution would for short periods of time permit successful through-migration of young salmon, conditions of lethal toxicity also developed, often very rapidly. Once stricken, the test fish quickly became disoriented and showed erratic behavior and aimless, non-directional swimming. They showed no avoidance behavior. Death usually followed rapidly.

The numbers of wild juvenile salmon actually killed by lethal conditions in these zones cannot be determined. In the first place, these young fish always sink when they die. Consequently, kills of juvenile salmon are not evidenced by floating dead fish as has been observed in these areas with other types of fish.

Secondly, in cases resulting in mortality, death was preceded by an inability to swim and avoid predators for periods up to 20 minutes after stricken. Therefore, some loss of wild fish must certainly occur from abnormally high predation, such as from seagulls or other fish-eating birds. In view of the number of fish observed in these areas and of the demonstrated frequency of toxic conditions, it is concluded that significant numbers of juvenile salmon are killed during migration in these areas.

The chemical tests associated with the bioassays showed that a number of conditions develop in the zone of acute pollution which either individually or in combination may cause fish mortality. These included conditions of low dissolved oxygen, low pH, and high sulfite waste liquor content, but most often implicated in these mortalities were the toxic gases produced by sludge bed decomposition.

BENTHIC STUDIES

While juvenile salmon are indirectly damaged by the sludge beds, the bottom-dwelling communities near the mills experienced considerable direct adverse effects.

The bottom life or benthos is an important segment of the marine community and includes many of the crustaceans, such as crabs, shrimps and barnacles; the mollusks, such as clams and snails; many types of worms; and a variety of other life. This bottom life is an integral part of the food web of Puget Sound. It has a substantial commercial and recreational fishing value in terms of crabs and clams and shrimps and bottom-feeding fishes.

Sludge deposits have an adverse effect on the natural benthic community of an area by eliminating many of the desirable species through burial and suffocation or exposure to toxic gases. This effect is manifested not only in terms of reduced numbers of organisms but in reduced population diversity, that is reduced number of kinds of organisms present.

Field sampling surveys were conducted in Bellingham, Everett and Port Angeles to determine the bottom-dwelling communities of these areas. Benthic organisms retrieved in grab-samples were identified and counted and the results were related to volatile solids content and thickness of the sludge blankets in the area. Up to seven kinds of benthos were found to inhabit areas of natural bottom composition beyond the area affected by sludge beds. The number of kinds was sharply reduced in those areas where sludge was present. No animals were found in areas of thickest sludge deposit, where volatile solids content exceeded about 30 percent. In large portions of the sludge covered areas only one kind of benthos was found and this was a pollution tolerant species of worm.

These observations of damage to marine life within the zone of acute pollution are not surprising. On the contrary, it would have been very surprising if such damages were not observed, since pollution levels in these areas are often well above those already known to be toxic to marine life.

Not so obvious, but of more far-reaching importance, are damages occurring to sensitive marine forms in the zone of chronic pollution. Recall that in this zone the main pollutional impact is the presence of dilute and often very dilute concentrations of sulfite waste liquor in the near surface waters. However, it is also in these waters where are harbored many of the very sensitive marine forms, the plankton, the egg and larval stages of most marine life.

At some phase of its life cycle, almost every marine animal is planktonic, that is it drifts passively with the currents or with only limited mobility of its own. For many of the finfishes and shellfishes of Puget Sound this planktonic phase occurs during early development, usually during the egg and larval stages. During these stages, the organisms lack many of the protective mechanisms of later development and are often adversely affected by relatively minor kinds and degrees of pollution.

Planktonic early life stages of a variety of marine animals are found in near-surface waters throughout Puget Sound. Among these are the larvae of shellfishes, oysters, clams and crabs, and the egg and larval stages of several species of important fish, including flounder, sole, cod and hake. To assess the extent to which pulp and paper mill wastes affect these sensitive organisms, extensive bioassay studies were conducted with Pacific oyster larva and English sole eggs.

These two test organisms are considered to be representative of a large group of marine organisms found in the study area which are expected to be similarly affected by pulp and paper mill wastes. This group includes some ten species of sole, six species of cod, anchovy, herring, smelt, several species of clams and crabs, just to mention a few of the more important ones.

The most extensive studies undertaken were the oyster larva bioassay studies which were conducted in cooperation with the Washington State Department of

Fisheries Shellfish Laboratory in Quilcene.

To acquaint you with this work and its pertinent results, Mr. Marvin Allum of our staff will discuss in some detail the oyster larva bioassay studies.

Mr. Allum.

STATEMENT OF MARVIN ALLUM
OF THE
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

MR. ALLUM: Thank you, Mr. Vlastelicia.

Mr. Chairman, Conferees, ladies and gentlemen.

Mr. Chairman, a good portion of this presentation will consist of slides. I have not prepared a text per se to accompany these slides. However, a summary of the material I am going to present is included in the material you already have, if that is satisfactory.

CHAIRMAN STEIN: Yes, sir. Will you comment on the slides as they appear?

MR. ALLUM: Yes, I will comment as we go.

CHAIRMAN STEIN: I notice there is a summary of your statement here. This summary will appear in the record as if presented, without objection, in addition to the comments you make as the slides appear.

(The summary referred to follows:)

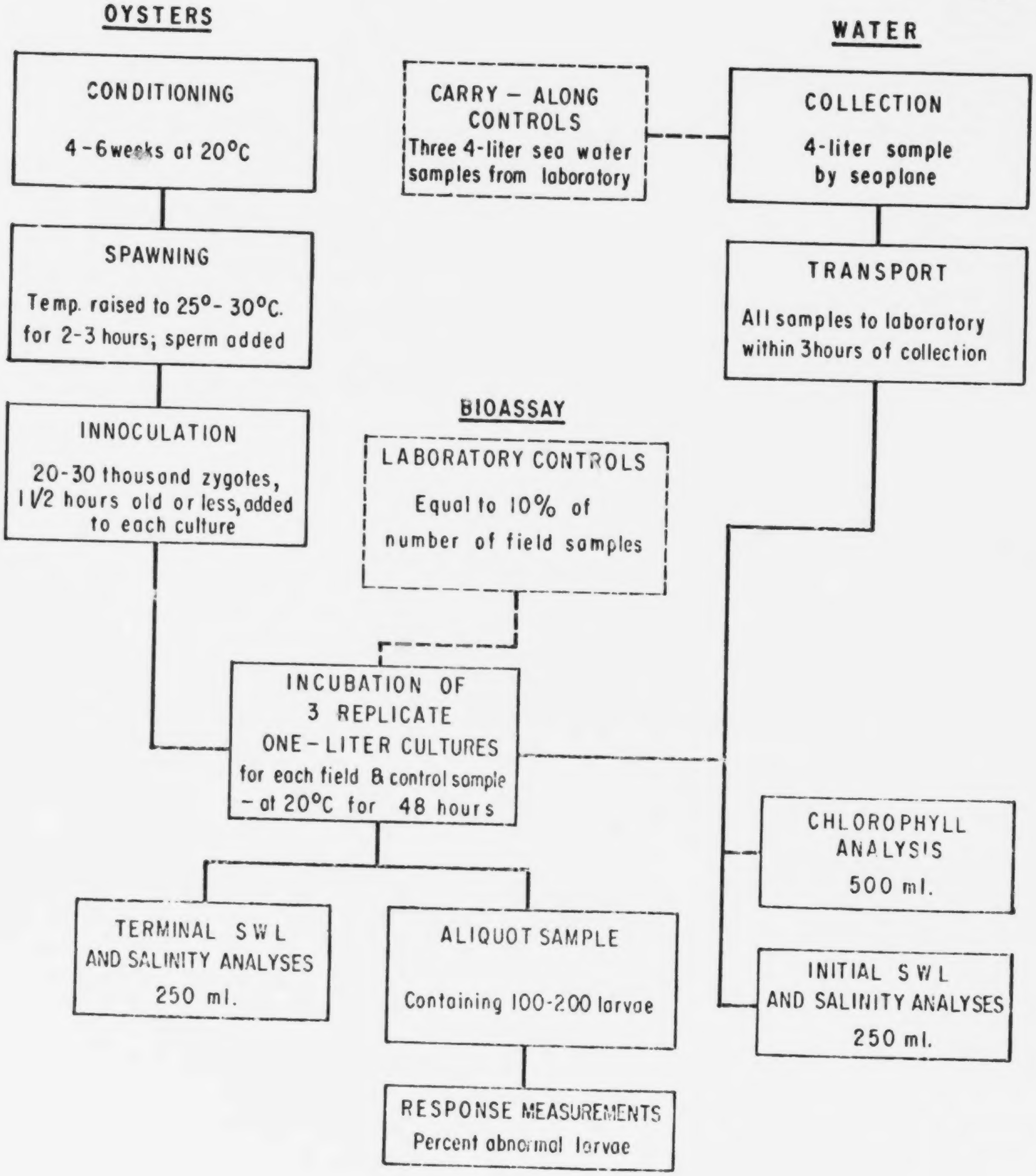
MARVIN ALLUM

"Oyster Larvae Studies -- (Summary of Mr. Allum's Discussion).

"The Project conducted two investigations using the larvae of the Pacific oyster as the test organisms. One was a field-sample study to measure the response of oyster larva to surface-water samples collected throughout each of the four study areas, and the other was a waste-sample study to determine the effects of the various waste streams of the pulp and paper mills on the larvae.

"The flow diagram, following, shows the basic features of the field-sample response study. The series of boxes to the left illustrates the procedures used to obtain fertilized eggs; the series to the right deals with the collection of field samples and the initial analyses for chlorophyll, salinity, and SWL; and the lower center series shows the steps in the bioassay test, the measurements of responses, and the terminal chemical analyses.

"Bioassay results were reported in terms of the percent of abnormal larvae in each culture after incubation. Larvae not fully shelled were counted as abnormal, whereas all fully-shelled larvae were considered to be normal, without regard to other abnormalities that might have been evident. This procedure avoided subjective interpretation in counting and provided a conservative


OYSTERS
WATER
CONDITIONING
4-6 weeks at 20°C
CARRY – ALONG CONTROLS
Three 4-liter sea water samples from laboratory
COLLECTION
4-liter sample by seaplane
SPAWNING
Temp. raised to 25°-30°C. for 2-3 hours; sperm added
TRANSPORT
All samples to laboratory within 3 hours of collection
BIOASSAY
INNOCULATION
20-30 thousand zygotes, 1 1/2 hours old or less, added to each culture
LABORATORY CONTROLS
Equal to 10% of number of field samples
INCUBATION OF 3 REPLICATE ONE-LITER CULTURES
for each field & control sample - at 20°C for 48 hours
CHLOROPHYLL ANALYSIS
500 ml.
TERMINAL S W L AND SALINITY ANALYSES
250 ml.
ALIQUOT SAMPLE
Containing 100-200 larvae
INITIAL S W L AND SALINITY ANALYSES
250 ml.
RESPONSE MEASUREMENTS
Percent abnormal larvae

Flow diagram of the field-sample oyster-larva response study.

measure. That this criterion is meaningful is attested to by the fact that repeated efforts to rear abnormal larvae to the juvenile oyster stage have all met with failure.

"The field-sample study was initiated in May 1963 and terminated in August 1965. Surface samples of water (field samples) were collected at monthly intervals from the stations in the four study areas. Extra sets of samples from some of these stations also were collected on July 6, 1964, and in November 1964, to evaluate water quality changes occurring during mill closure periods. Samples were air transported to the Washington State Department of Fisheries Shellfish Laboratory for the bioassays.

"In the waste sample study, 24-hour composite samples were collected from individual mill waste streams. Aliquots of these samples were analyzed for SWL, total solids (fixed and volatile), suspended solids (fixed and volatile), total sulfur, BOD_5, and COD. The samples were shipped under refrigeration to the Washington Department of Fisheries Shellfish Laboratory where they were immediately prepared for bioassay. Serial dilutions of one part waste sample to 10, 20, 100, 200, 1,000, 2,000, 10,000, 20,000, 100,000, and 200,000 parts of fresh unpolluted seawater (laboratory water supply) were made. For each waste sample, percent-abnormal values from the several dilutions were plotted on probit paper against the appropriate dilution ratios and SWL concentrations. From the line of best-fit, dilution ratios and SWL values for the 0, 20, 50, and 100% abnormal levels were determined.

"All bioassays and associated laboratory analyses were performed or supervised by Charles E. Woelke of the Laboratory's staff. The results of the waste-sample study were analyzed and evaluated by Mr. Woelke; the results of the field-sample response study were statistically analyzed by Dr. Gerald J. Paulik, Biometrician, University of Washington School of Fisheries.

"The results of the field-sample study are fully presented and discussed by Dr. Paulik in a final report to the Project. However, only those data (1) derived from or associated with bioassay responses not influenced by low salinity and poor test-animal stock and (2) those associated with normal mill operations, i.e., the usual ranges of water quality and environmental factors prevailing in the study area--are included here. The rationale for limiting the data is given in the Project's final report.

MARVIN ALLUM

"Briefly, the field-sample study clearly demonstrated the adverse effect of pulp and paper mill wastes on the marine environment in that:

"1. The number of abnormal larvae increased as SWL concentration increased;

"2. The number of abnormal larvae increased as the distance from each mill's discharges decreased (and SWL increased);

"3. When the pulp and paper mills were not operating, as during the November 1964 strike, larval abnormality dropped to near zero in the strike-affected study areas; but remained at about the usual levels in the Everett study area where one of the mills continued production.

"4. When production in the strike-affected areas was resumed, larval abnormalities immediately climbed back to the former levels;

"5. Larval abnormality began to increase very rapidly at SWL concentrations of about 10 ppm and reached near-100% at 40 to 60 ppm SWL, depending on the study area.

"It is interesting to note that contrary to the contention that SWL concentrations (as measured by the Pearl-Benson test) of 10 ppm or less are 'background' levels--i.e., attributable to substances other than SWL--

the levels of SWL fell to zero, or nearly so, in all of the strike-affected areas when production ceased.

"The waste-sample study revealed the most toxic components of pulp and paper mill wastes are associated with chemical-pulping processes. It was also found that many of the individual waste streams were toxic (i.e., caused 20% abnormality) at or below SWL levels once considered as 'background'--3 ppm and less. This implies that the absence of high SWL levels in areas receiving pulp mill wastes does not rule out the mill as a source of damaging wastes."

MARVIN ALLUM

CHAIRMAN STEIN: You may proceed, Mr. Allum.

MR. ALLUM: Thank you.

OYSTER LARVAE STUDIES

The Project conducted two investigations using the larvae of the Pacific oyster as the test organisms. One of these studies was a field sample study to measure the response of the oyster larvae to surface water samples collected throughout each of the four study areas, and the other study was conducted to determine the effects on the larvae of the various individual waste streams from each of the mills and thus determine the relative toxicity of the waste components at each mill. The effluents of oil refineries at Mark Point near Anacortes were also tested by this method.

The field sample study was initiated in May 1963 and was terminated in August of 1965. Surface samples of water in the field samples were collected at monthly intervals from various stations in the four study areas. Extra sets of samples were collected from some of these stations on July 6, after a three-day 4th of July holiday, in which production was shut down, and again in November of 1964, during the period when most of the mills in the study areas were closed because of a labor strike, to evaluate water quality changes occurring during the mill closures. Samples were air transported to the Washington State Department of Fisheries Shellfish Laboratory for the bioassays.

In the waste sample study 24-hour composite samples were collected from the individual mill waste streams. Aliquots of these samples were tested for sulfite waste liquor and other components and the samples were shipped under refrigeration again to the fisheries laboratory at Point Whitney, where they were immediately prepared for bioassay. Serial dilutions of one part of waste sample to 10, 20, 100, 200, and so on, parts of seawater from the laboratory supply were made. For each waste sample, percent abnormal values from the several dilutions were plotted on probit paper against the appropriate dilution ratios and sulfite waste liquor concentrations. From the line of best-fit, dilution ratios and associated sulfite waste liquor values for the 0, 20, 50 and 100 percent abnormal levels were determined.

All bioassays and associated laboratory analyses were performed or supervised by Charles Woelke of the laboratory's staff. The results of the waste sample study were analyzed and evaluated by Mr. Woelke; the results of the field sample response study were statistically analyzed by Dr. Gerald Paulik, who is a Biometrician at the Washington University School of Fisheries.

By means of slides we will examine in some detail the field sample bioassays, using oyster larvae as response organisms. Essentially the same technique was used in the waste sample studies.

CHAIRMAN STEIN: Pardon me, Mr. Alum. Do you want these slides to be made part of the record?

MR. ALLUM: There are quite a number of them and the only ones we have are in color and I don't think they would reproduce very well for the record.

CHAIRMAN STEIN: How many copies do you have of those you have?

MR. ALLUM: We have two sets, I think, within our organization and could have some copies made from the originals which Mr. Woelke has.

CHAIRMAN STEIN: I think it might be wise for the record if you will identify these slides by number as slides 1, 2, 3, 4, and we will have a set available, if this is agreeable to you and the Conferees, in the Regional Office in Portland, who will make a set available to Mr. Harris to have at his office in Olympia, and we will have a set available in Washington so anyone who reads the record and wants to refer to the slides can get these. At least in the Federal offices these slides will be available for inspection and projection during normal business hours on application.

(The slides referred to are marked Exhibit 2 and are on file at the FWPCA Headquarters in Washington, D.C., with copies on file at the FWPCA Regional Office in Portland, Oregon, and the State of Washington WPCC office in Olympia, Washington.)

CHAIRMAN STEIN: Now, I would suggest, so the record is meaningful, that we designate this as slide probably FG-1, for Federal Government, and you don't have to say FG, Mrs. Rankin will take it down, but just identify them so we know what you are talking about.

This is slide FG-1. Will you proceed, Mr. Allum.

MR. ALLUM: I will attempt to keep track of these by number. I generally keep track of them by content.

CHAIRMAN STEIN: That is right. But you know, when someone reads the record who isn't here and you talk about a slide that isn't identified and they want to check on it, it is a little difficult.

MR. ALLUM: Right.

CHAIRMAN STEIN: We have to think in terms of the record and the people who aren't here or that are not as familiar with the content as you are. We have to think of their needs and the perfection of the record.

So I would appreciate it if you could just keep these in numerical sequence.

MR. ALLUM: Yes, I will try to do that, Mr. Chairman. Perhaps Mrs. Rankin can help me keep track of the content.

(Slide FG-1)

First of all, this first slide shows merely that oysters are collected from their natural growing areas and are taken to the laboratory--

(Slide FG-2)

--where they are held for a period of six to eight weeks at about 20 degrees Centigrade. During this time the reproductive organs of the oysters ripen and they are physiologically then capable of spawning.

(Slide FG-3)

For a particular sampling trip, the investigator and the pilot beforehand get together, determine what stations they are going to visit, in what order and sequence, and so on.

(Slide FG-4)

In the laboratory the lab technician does a little calculating as to when he will need to have the oysters spawning. He determines that the plane left at about 11 a.m. and would return at about 1 o'clock. He plans, then, to start his spawning at about 12:45 p.m. The technique is relatively precise.

(Slide FG-5)

5. At about 11 o'clock the oysters are placed in somewhat warmer water than that they have been

in, about 30 degrees. This warmer water then induces spawning within a relatively short time.

(Slide FG-6)

Occasionally it is necessary to add sperm to the dishes to help out with the spawning. In the meantime, the plane has stopped at the first of the sampling stations. This one happens to be at Anacortes. We are looking down at Fidalgo Bay.

(Slide FG-7)

The plane lands and a surface sample is collected in a plastic container. You will note that this is strictly a surface sample. In the background in the doorway you can see another plastic container. This is a carry-along control, a sample of water that is taken throughout the flight to assess any stresses that may occur because of the transportation method or handling of the samples en route.

(Slide FG-8)

The plane then visits the next sampling area, and this happens to be Bellingham.

(Slide FG-9)

And a third area at Port Angeles.

(Slide FG-10)

Then the plane returns, usually well within two hours, never more than three hours later, to the laboratory at Point Whitney.

(Slide FG-11)

The samples are transferred to a vehicle and are immediately taken to the lab.

(Slide FG-12)

During the time the samples have been--are being collected and right on time the oysters have spawned.

(Slide FG-13)

To insure adequate fertilization, even though on most occasions sperm is added to the dishes with the female oysters to induce spawning, to insure that all eggs are fertilized additional sperm is added to the egg suspension, which is, of course, collected from the dishes.

(Slide FG-14)

Then while gently stirring the now fertilized eggs to keep them in suspension, because they will naturally sink, a small portion of the egg suspension is placed in a beaker and--

(Slide FG-15)

--sterilized and filtered laboratory water is added to provide some dilution for the eggs in the beaker and are left there millions and millions of eggs, and since it is necessary to count these, a dilution to more countable portions is needed.

MARVIN ALLUM

(Slide FG-16)

Again keeping the eggs gently agitated to keep them in suspension and evenly distributed throughout the water mass, a small sample is withdrawn--

(Slide FG-17)

--placed on a microscope slide and examined under the compound microscope.

(Slide FG-18)

And the round objects that you see here on the screen are freshly fertilized oyster eggs. I don't see any there yet that have begun to divide.

(Slide FG-19)

The feed samples then that have been brought in by plane are divided into three one-liter samples. Each sample then is run in triplicate.

(Slide FG-20)

The remaining portion of the field sample is tested for sulfite waste liquor by the Pearl-Benson Index, the salinity is determined and chlorophyll is also determined. It was found during some of the earlier studies that certain amounts of chlorophyll did seem to have some effect on the larvae. To insure that we were not looking at results due to extra amounts of chlorophyll, chlorophyll was routinely done as a check.

MARVIN ALLUM

(Slide FG-21)

Then to each of the three beakers for each sample an aliquot portion of eggs is distributed to try to get from 20,000 to 30,000 eggs per beaker.

(Slide FG-22)

The beakers then are incubated at 20 degrees Centigrade in a water bath. Now, in actual practice these beakers would be covered and would be in a somewhat larger container.

(Slide FG-23)

48 hours later the eggs are concentrated or removed from the sample by pouring the sample through a 35-micron mesh sieve. Note that the water passing through is being collected.

(Slide FG-24)

The water minus the eggs is again subjected to the Pearl-Benson Index for sulfite waste liquor to insure that no changes have occurred during the 48-hour period and the salinity is also checked to insure that this parameter has not changed during the test.

(Slide FG-25)

The eggs then that are collected in the 35-micron screen collector are subsequently washed into a beaker of sterile filtered seawater.

MARVIN ALLUM

(Slide FG-26)

This, then, is diluted for much the same reason that the egg suspension was diluted initially and that is to get the 20,000 to 30,000 now larvae diluted to the point that a countable sample can be taken.

(Slide FG-27)

As you see here, then, an aliquot of this dilution is taken--

(Slide FG-28)

--placed in a small vial and a little formalin is added to preserve the sample until the counts can be made.

(Slide FG-29)

Later on the sample is transferred again to a microscope slide and--

(Slide FG-30)

--with the compound microscope we examine the straight hinge larvae that result after 48 hours of incubation at 20 degrees. In the lower right-hand corner is a larva which would be counted as normal. The next to the last on the left lower would also be counted as normal. All of the other larvae shown here show some evidences of abnormality. In actual practice, the criterion that was used was whether or not shell development was adequate and covered the soft parts of the larval body. Even though some other abnormalities may have been evident, only this criterion was used throughout so as to provide a workable criterion for all concerned.

(Slide FG-31)

Now we will review briefly the technique again with this flow diagram, which, incidentally, is in Page 135 of the project report. It is also following the Page 14 of the summary that many of you have.

Before passing from the abnormal larvae let me say that repeated attempts to rear abnormal larvae such as the ones you saw have all met with failure. No successful attempt has ever been made to rear these to juvenile or adult oysters.

Now, the results of the field sample study are fully presented and discussed by Dr. Paulik in a final report to the Project and, of course, are discussed fully in the Project's final report itself. However, in the data that we are going to examine next, only those data derived from or associated with bioassay responses not influenced by low salinity and poor test-animal stock and those associated with normal mill operations, that is aside from strike periods when the usual ranges of water quality and environmental factors prevail, are included here. The rationale for limiting the data to these is given in the Project's final report.

Let's take a look at the results of these studies, beginning first with the field sample bioassay study.

(Slide FG-32)

This is the Bellingham area.

Are those figures clear enough, Brian?

MR. JOHNSON: I think so.

MR. ALLUM: (Slide FG-32) Beginning at Bellingham at the point closest to the mill, for those of you who may not be able to read it, we have what appears to be a fraction. The numerator of the fraction is the percent abnormal oyster larvae, mean percent abnormal oyster larvae, taken over quite a number of tests. The denominator is the mean sulfite waste liquor value for that station as determined by the Pearl-Benson Index. In this case at the station closest to the mill you will note that the mean percent abnormal was 100 percent. The mean sulfite waste liquor was 1,120 parts per million.

Proceeding then down the east shoreline of Bellingham Bay and near Post Point, we have 91 percent abnormals, 245 parts per million average sulfite waste liquor.

The next, 68 and 104.

MARVIN ALLUM

The next 26 percent and 24 parts per million.

Dropping down rapidly to 4 percent and about 6 parts per million of sulfite waste liquor.

2-1/2 percent and about 4 parts per million of sulfite waste liquor.

2 percent and 2 parts per million of sulfite waste liquor.

And then out on Wind Point we have 8-1/2 percent abnormals and about 6 parts per million of sulfite waste liquor.

At this point (indicating) we have 13 percent abnormal larvae and about 95 parts per million of sulfite waste liquor on the average--9.5. I need my glasses.

Then proceeding again up towards the mill, we have 33 percent and 19.

20 and 14.

And again getting in closer to the mill, 69 percent and 59 parts per million sulfite waste liquor on the average.

Now in the Anacortes area, beginning at the point near the discharge of the Scott Mill, we have 2.8 percent abnormals and an average sulfite waste liquor of 110. Now, I should point out that at this station we usually got either a very low percent of abnormals or 100 percent.

The sampling point, depending upon the tide, was either within the influence of the mill discharge or on another tide, outgoing tide, for example, would be outside of the point of influence of the mill discharge. The tide moves quite rapidly through the channel.

Then out towards the end of the channel we have 3.6 and about 3.

Over in Fidalgo Bay 6.1 percent and about 2.2 average sulfite waste liquor.

Further down into the bay 2.3 and 1.2.

Over into Padilla are relatively low values.

And finally down in Smelt Bay 9.0 and about 4 parts per million.

Now, in contrast to what we see here, let's take a look at the situation after the mills have been closed for about 12 days in November '64 when a labor strike closed all but the Weyerhaeuser Mill in Everett.

(Slide FG-33)

As you can see, there is a considerable difference when the mills are operating and when they are not. Unfortunately, the previous station there could not be collected--was collected, excuse me, but the salinity was so low that we could not use the data, and frequently as we look at these data obtained during mill closures you will find stations that are missing. There are two possible reasons. Either the salinity was so low we could not use the sample or because of weather conditions it was impossible to land and take off at that particular station on the day those samples were collected. These samples, as you recall, are collected by float plane, and we need fairly decent weather to get down and pick them up.

In any case, note here at Post Point, less than 1 percent abnormal, a sulfite waste liquor value of 5 parts per million. This contrasts with a mean value at this point of 245 parts per million taken during our ordinary sampling and a 91 percent abnormal level at that point.

The next station, then, proceeding again down the east shore, less than 1 percent abnormals and less than 1 part per million of sulfite waste liquor.

At this station (indicating) again less than 1 percent abnormals and 0 sulfite waste liquor.

At this point (indicating) less than 1 percent again and less than 1 part per million.

William Point, less than 1 percent and 0 sulfite waste liquor.

At this station (indicating) we have almost 2 percent abnormals, 0 sulfite waste liquor. This 2 percent,

MARVIN ALLUM

incidentally, is within the range of our controls.

At that point (indicating) less than 1 percent abnormals and 0 sulfite waste liquor.

There (indicating) 2 percent abnormals and 1 part per million sulfite waste liquor.

There are two things, I think, we will want to keep in mind as we examine the results from mill closures and that is that when the mills are not operating sulfite waste liquor values as determined by the Pearl-Benson Index fall to or very near zero. Further, that the abnormalities of oyster larvae also fall to or very near zero.

(Slide FG-34)

In the Anacortes area, look at the lower portion of the slide, we were unable to get the entire gamut of samples here because of weather conditions. Only two stations are represented, but note that at this point (indicating) we had 7-tenths of 1 percent abnormals and about a half percent there (indicating). The sulfite waste liquor values are not included on this particular one, if they are in the previous one. They were less than 1 or 0, 0 at this point or less than 1 at that point.

The usual values found during our survey are shown in the upper portion, notice there (indicating), almost 29 percent, about 4 percent here (indicating), and so on.

Let's move on down Puget Sound a ways.

(Slide FG-35)

This represents the Everett area. Now, beginning out at East Point we find that our mean abnormal larva percentage was about 4 and the mean sulfite waste liquor concentration was about 6.

At this station (indicating) almost 3 percent abnormals and 7 parts per million sulfite waste liquor.

At Hat Island, or Gedney I guess it is called, (indicating) about 10 percent abnormals accompanied by 10 parts per million of sulfite waste liquor.

Now as we move in close to the point of discharge of the deep water district diffuser utilized by Weyerhaeuser and Scott companies, we find that we have 77 percent abnormals and an average sulfite waste liquor of 77.

Moving then away from this point of discharge we begin to drop down to 63.3 and 31 parts.

66 percent and 21 parts.

And at Mukilteo 48 and 16.

And on down along the shore south of Mukilteo a little over 6 percent with 6 parts.

Across near Possession Point 13 percent and 9 parts per million.

And 13 percent and 10 parts per million (indicating).

Now, during the strike affecting most of the mills in November of 1964, a portion of the Weyerhaeuser plant at Everett continued production. I understand that about 60 percent production was maintained by the Weyerhaeuser mill during the strike period. The Scott mill, I am told, was shut down completely. In any case, the production that did continue there did not provide us with a clear contrast of production versus no production, so that we have no data for the strike period inasmuch as sulfite waste liquor values and abnormalities at that time were essentially the same as they were during our routine sampling trips at other times. In other words, the contribution of the one mill was sufficient to give us about the same results we had when both mills were operating, somewhat reduced.

So in order to get some comparison of production, we are going to present some data obtained on July 6 following a three-day holiday versus our mean results for the stations indicated.

(Slide FG-36)

Now, Station 1 is at East Point up in Saratoga.

Station 3 is at Gedney or Hat Island.

Station 7 is near Mukilteo, just north of Mukilteo.

Station 8 is south of Mukilteo along the east shore.

And Station 10 is across Possession Sound and near the point itself, Possession Point.

These data are not earth-shaking, but we do see that there is some reduction in the three days of mill closure.

On July 6 you will note sulfite waste liquor values parts per million were running 4 and 5 parts per million throughout these five stations. This is compared with the mean sulfite waste liquor found at these very same stations throughout the study, and you will note that these mean values are somewhat higher.

Then in the columns on the right the percent abnormals are shown for July 6, and you will note that they drop down to 2.9, about 3 percent, at the highest and as low as 1 percent. The mean, however, for these same stations, as you will note, is considerably higher.

Now, we did not omit data because it wasn't favorable to our cause here. Again we are faced with a problem of picking up the samples, to begin with, and, secondly, using only those samples in which the salinity was 20 parts per thousand or more, since lower salinities in themselves do affect the larvae. So the fact that only these five stations are shown does not reflect a selection of data to present a picture, but only that these were the only comparable stations we had data for at both times.

(Slide FG-37)

Then moving out on the strait to the Port Angeles area, we see the results of our over-all study. Off there (indicating) and off the range of this map is Fresh Water Bay, which was one of our so-called control stations, and you will note that the over-all percent abnormals here are less than 2 percent and the over-all mean sulfite waste liquor was less than 1 part per million.

Moving in then closer to Port Angeles itself, another sort of control station about a mile off Ediz Hook, we have an average of less than 2 percent abnormals and an average sulfite waste liquor mean of 1 part per million.

Then at the tip of Ediz Hook we have 2 percent abnormals and a little over 3 parts per million sulfite waste liquor.

Going then to the west end of the harbor, we have about 82 percent and 250 parts.

Moving then toward the center of the harbor, 62 percent and 128 parts.

Then near the Rayonier mill we have an average of 90 percent abnormals and an average sulfite waste liquor value of 1,370 parts.

Then on the other side of the mill we have 95 percent abnormals and an average concentration of sulfite waste liquor of 3,365 parts per million.

Moving then on out towards Dungeness Spit, at this point we have almost 87 percent abnormals and 270 parts per million.

A little bit further out, 79-1/2 percent and 33 parts per million sulfite waste liquor.

A little further out 32 percent and 15 parts.

(Indicating) 6.2 and about 9 parts.

And finally at the tip (indicating) 9 and about 1 part.

(Slide FG-38)

Now let's take a look at the situation during the mill closure. These samples were taken about 11 days after the mills were closed by the strike.

Again over in Fresh Water Bay not much change, about a half a percent and 0 sulfite waste liquor.

We could not land at that point because of the rough seas.

At the tip of Ediz Hook we again encountered the same problem.

By getting inside the bay then at this point (indicating) we had 1 percent abnormals and less than 1 part per million of sulfite waste liquor.

Near the center of the harbor (indicating) we had a half percent abnormals and 0 sulfite waste liquor.

We did not get data at that point (indicating).

At that point (indicating) we had 1.3 percent and 0 sulfite waste liquor.

And continuing on out toward the tip of Dungeness Spit, about a half a percent and 0 (indicating).

A little over 1 percent (indicating) and 0.

(Indicating) About a half a percent and 0.

(Indicating) About 1 percent and less than 1 part per million of sulfite waste liquor.

And at the tip of Dungeness Spit (indicating) about 2 percent and less than 1 part per million of sulfite waste liquor.

Now, examining carefully these data collected during mill closure, it is interesting to note that contrary to the contention of many of the workers in this particular field that the sulfite waste liquor concentrations of 10 parts per million or less represent background values or, in other words, are attributable to some substance other than sulfite waste liquor. You can, of course, note that sulfite waste liquor values fell to zero or nearly so in all of the areas in which production was stopped during the strike. You will also note that larva abnormalities fell to zero or nearly so in all of the areas in which production ceased.

Now let's take a look at some of the data obtained from the waste sample study, and here we are trying to determine the relative toxicity of the various streams within each of the mills.

(Slide FC-39)

In the manner described before, the amount of dilution required for each waste stream to dilute it to the point where it would not affect oyster larvae was calculated. These values are given in the right-hand column.

And for the Georgia-Pacific Mill at Bellingham you will note that the alcohol plant effluent would require about 85,000 cubic feet per second to dilute it to the point of no damage to oyster larvae. For those of you who are not familiar with the term "cubic foot per second," it is a little over 600,000 gallons per day.

The bleach plant, as you note, about 41,000 cfs.

For pulp washing and screening, 26,800.

And so on in lesser amounts for other mill processes.

The paper mill itself 820 cfs would be required for dilution there.

The Scott Mill at Anacortes would require some 877,000 cubic feet per second to dilute the material to a point of no damage to the oyster larvae.

The Shell Oil Refinery and the Texaco Oil Refinery were also tested and the total effluent required for Shell 65 cfs and for Texaco Oil Refinery about 460 cubic feet per second.

Also to perhaps put this in some frame of reference that may mean more to us who have worked with this sort of data, the Columbia River average flow is about 100,000 cfs annual flow, annual mean.

(Slide FG-40)

Now in the Everett area we note that the digester from the Scott Sulfite Mill would require a little over 2 million cfs dilution to render it harmless to oyster larvae.

For the Weyerhaeuser Sulfite Mill you will note that the digester wastes again are quite strong and when combined with the caustic extractor wastes would require about a million and a half cfs for dilution.

Other plant operations, as you see, are less.

Now, one thing that we can see here and have seen before, with the Georgia-Pacific as well, is that the stronger wastes are associated with the pulping process and the further you get from the pulping process the weaker the wastes become.

(Slide FG-41)

Now finally the Port Angeles area for the Rayonier Mill, which includes pulping wastes, I am told, 323,000 cfs or a little over, screen room a little less, the barker a little less yet.

Fibreboard Products' composite sewer, which includes all their waste streams, 71,000-plus cfs.

Crown Zellerbach Company uses a somewhat different process than the rest of the mills so far discussed in that they use mechanical pulping, and consequently the wastes do not appear to be as toxic to the larvae as are the chemical pulping processes.

Now, this waste sample study, as I said before, revealed that the most toxic components of pulp and paper mill wastes are associated with the chemical pulping processes. Now, interestingly enough, when the data for the individual waste streams were arranged by dilution ratio, in other words, much as they are here, as arrayed here, much as in the cases of Rayonier where the strongest is first, the next strongest second and the weakest last, when the data are arrayed in this fashion the sulfite waste liquor values that accompany these dilution ratios do not form any particular pattern. In other words, the waste requiring the most dilution may or may not have had the highest sulfite waste liquor value associated with it. The second strongest by dilution factor may or may not have had the second highest sulfite waste liquor value, and so on. Now, this suggests to us that either more than one toxic component exists in the wastes that were tested or that the Pearl-Benson Index for sulfite waste liquor does not adequately measure whatever this toxic component may be.

Almost everyone who has worked with pulp mill wastes has found that the Pearl-Benson Index is something less than perfect. This, too, was our experience.

However, it does indicate the presence of sulfite waste liquor and recall again the levels found during the normal mill operation as compared to those during the strike-downs for all of the areas in which production ceased, and further if sufficient samples are tested the mean or average sulfite waste liquor value is, in our opinion, significant.

In summary, the field sample study clearly demonstrated the adverse effect of pulp and paper mill wastes on the marine environment in that:

The number of abnormal larvae increased as sulfite waste liquor concentrations increased.

The number of abnormal larvae increased as the distance from each mill's discharges decreased and, conversely, sulfite waste liquor increased.

When the mills were not operating, as during the November '64 strike, larval abnormality and sulfite waste liquor values dropped to near zero in the strike-affected study areas, but both these parameters remained at about the usual level in the Everett study area where the Weyerhaeuser Mill continued at 60 percent production.

And when production was resumed in the strike-affected areas, larval abnormalities climbed immediately back to their former levels as did sulfite waste liquor concentrations.

These studies have shown also that background levels of sulfite waste liquor are essentially zero in the absence of pulping wastes.

The studies also demonstrated that the most toxic components of the total mill wastes are those associated with the chemical pulping process.

Mr. Vlastelicia will continue the presentation.

CHAIRMAN STEIN: Just a moment. May we have the lights, please?

Before you go off--and that was a very complete presentation, Mr. Allum.

MR. ALLUM: Thank you.

CHAIRMAN STEIN: I will have to ask that the slides that are made available for the files be numbered right on the slide, and you can use an FG number starting with 1, on the frame, so when those slides are projected on the screen the person examining them will be able to see the number and relate it to the record.

I think this might be a good breaking point for a recess if we are going to take the morning for the Federal presentation, so we will stand recessed for ten minutes.

(RECESS)

CHAIRMAN STEIN: May we continue with the Federal presentation. As we sit down, Mrs. Rankin said I called her Miss Hough once or twice today and people wouldn't think that I knew her as well as I said I did. Just for your information, Miss Hough was her maiden name and she hasn't been Miss Hough for, I don't know, at least ten years. That shows you how well I really do know her.

Mr. Poston.

MR. POSTON: I am going to turn the meeting back to Mr. Vlastelicia, who will carry on.

STATEMENT OF JOHN VLASTELICIA
OF THE
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

MR. VLASTELICIA: Mr. Chairman, the oyster larva bioassay studies just presented by Mr. Allum represent one of the most exhaustive such studies ever conducted to evaluate the effects of sulfite waste liquor on developing marine organisms. The findings lay the groundwork on which to define abatement recommendations, particularly the finding that a toxicity threshold exists as sulfite waste liquor concentrations increase beyond about 10 parts per million, and also worth noting, I think, again, is the essential disappearance of oyster larvae abnormality with a cessation in pulp mill operations, such as during the labor strike.

FLATFISH STUDIES

Now, the Project also conducted similar bioassay studies using the eggs of English sole, a commercially important flatfish of Puget Sound. The English sole, along with many other important species of flatfish, and other fishes as well, hake, codfish, and so on, spawn in the shallower bays of Puget Sound. The eggs of these fishes float after hatching and subsequent embryonic and larval development takes place in the near-surface waters. Flatfish egg occurrence studies demonstrated that substantial numbers of these eggs are found in the zones of chronic pollution in both the Bellingham and Everett study areas.

The English sole egg bioassay study was conducted at the University of Washington's Friday Harbor laboratory in a manner very similar to the waste sample portion of the oyster larva bioassays. English sole eggs were fertilized in the laboratory and incubated in dilutions of sulfite waste liquor ranging in concentrations from 6 parts per million to 1,000 parts per million. After incubation, the eggs and larvae were examined under a microscope to determine the response, either in terms of injury or retarded development to the various waste levels.

The results showed that sulfite waste liquor, even when dilute, is damaging to English sole eggs. The effects range from the ultimate damage of killing the egg to the relatively subtle damage of delaying hatching time. Significant damage was rarely seen in sulfite waste concentrations of 6 parts per million but always seen in 14 parts per million and this indicates some sort of a toxicity threshold of about 10 parts per million or very similar to that for the oyster larva bioassay studies.

OTHER BIOLOGIC STUDIES

There were other important biological studies conducted by the Project. Studies of adult and juvenile oysters showed that oyster mortalities increased, and the growth rate and market quality decreased, with proximity to the waste source. Phytoplankton productivity studies showed a definite productivity suppression in the zone of acute pollution. Phytoplankton, as you know, produced some of the desirable dissolved oxygen content of these waters. Studies were made of the zooplankton, the minute marine animals, of the area, and of the periphyton, these tiny marine organisms, both plant and animal, which attach themselves to rocks and logs. Surveys were made to assess the bacteriological quality of study areas. Surveys were made to determine waste characteristics of certain industries other than pulp and paper mills, and of municipal waste discharges.

Now, so far this morning we have summarized the general work and findings of the Washington State Enforcement Project. Let's now consider the specific pollutional effects in each of the four study areas and the requirements to abate those effects.

AREA EVALUATIONS AND ABATEMENT RECOMMENDATIONS

In preview, as we go from area to area and from mill to mill, much of the following part of today's presentation will seem quite repetitious, but this will serve two purposes. First for you and for the Conference record it will outline specifically just what the findings are for each area and for each mill. And secondly, it should illustrate, I think, the universality, if I can say that, of the pollutional effects of pulp and paper mill wastes in this area and in the abatement requirements.

We will first consider the Bellingham study area.

BELLINGHAM

The Georgia-Pacific Corporation's pulp, board, and paper mill located on Whatcom Waterway is the

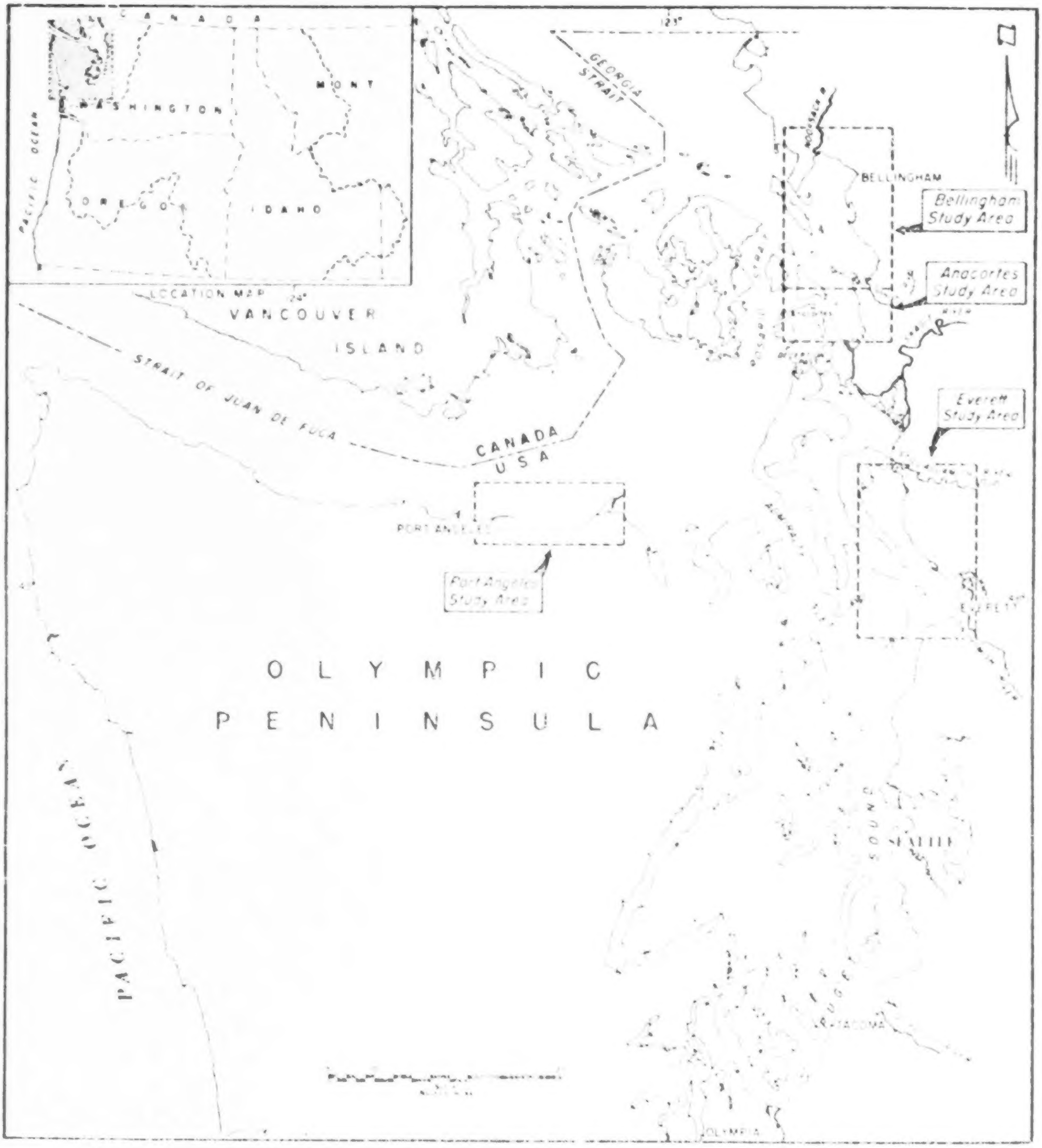

CANADA
WASHINGTON
MONT
OREGON
IDAHO
PACIFIC OCEAN
LOCATION MAP
124°
123°
GEORGIA STRAIT
VANCOUVER ISLAND
STRAIT OF JUAN DE FUCA
CANADA
USA
BELLINGHAM
Bellingham Study Area
Anacortes Study Area
Everett Study Area
PORT ANGELES
Port Angeles Study Area
EVERETT
OLYMPIC PENINSULA
PACIFIC OCEAN
SEATTLE
TACOMA
OLYMPIA

FIGURE #1 Puget Sound - General study area.

principal source of wastes present in waters of the Bellingham study area. These wastes discharge directly into Whatcom Waterway adjacent to the mill and are found dispersed in near-surface waters throughout the Bellingham-Samish Bay system, on occasion even in the Anacortes area some 12 to 14 miles distant.

Our studies demonstrated that waste levels present in the system are excessively damaging to the indigenous marine community. These damages are essentially of two specific types:

First, those of an acute nature, occurring mainly in the Bellingham Harbor area and associated with concentrated sulfite waste liquors and settleable solids bearing wastes discharged into Whatcom Waterway;

And secondly, those damages of a more chronic nature occurring throughout the outer waters of the Bellingham-Samish Bay system and associated with dilute concentrations of sulfite waste liquors.

In Bellingham Harbor, waste discharge from the Georgia-Pacific mill results in high waste concentrations, sludge deposits, and attendant water quality degradation. Specifically, the wastes have been shown to:

First, be injurious to juvenile salmon, resulting in extensive damage to the salmon fishery while juveniles are migrating through the harbor area.

Secondly, they have been shown to suppress phytoplankton activity in the harbor.

And third, they have been shown to contain settleable waste solids, some 18 tons per day, that form sludge deposits in Bellingham Harbor. These deposits damage bottom organisms and produce harmful water quality degradation, as well as cause general aesthetically unattractive conditions.

Of even greater importance to the marine communities of the study area are the concentrations of sulfite waste liquor found dispersed throughout the Bellingham-Samish Bay system. We have previously shown that these wastes, even in relatively dilute concentrations, say 5 to 15 parts per million, are damaging to immature forms of indigenous fish and shellfish, with such damages generally decreasing with distance from the waste source. Specifically, our studies have shown this:

One, that they damage oyster larva throughout the Bellingham area, with excessive damage produced in northern Bellingham Bay.

Two, that they cause some adult and juvenile oyster mortality, particularly in Bellingham Bay, but more importantly, they adversely affect oyster growth and market condition throughout the Bellingham-Samish Bay system.

And third, they have been shown to damage English sole eggs which are seasonally present in the surface waters throughout this study area. Extensive damage would be expected at waste levels found in northern Bellingham Bay, with lesser damages expected in the remainder of the Bellingham-Samish Bay system.

The physical characteristics of the Bellingham-Samish Bay system severely limit its ability to assimilate large inflows of waste products. To prevent additional damages to the important marine resources, it is, therefore, necessary that sulfite waste liquors discharged by Georgia-Pacific Corporation be reduced significantly at the source. Minimum protection of the organisms during their most sensitive life stages requires that sulfite waste liquor concentrations in the surface 50 feet of water not exceed 10 parts per million beyond an initial waste dispersion zone. The initial waste dispersion zone suggested by the Project for Bellingham area is defined as that area of Bellingham Bay north of an east-west magnetic line from Post Point to Lummi Peninsula. This encompasses about 16 square miles of the northernmost part of Bellingham Bay.

In other studies, bacterial studies demonstrated that the discharge of raw and partially treated domestic wastes from the City of Bellingham results in bacterial concentrations in the Bellingham Harbor hazardous to human health.

RECOMMENDATIONS

To provide abatement of pollution occurring in Bellingham Harbor and throughout the Bellingham-Samish Bay system, the Project recommends this:

For Georgia-Pacific pulp, board and paper mill, five recommendations: First, provide primary treatment of all solids-bearing wastes to obtain removal of all settleable solids and to obtain 70 percent removal of volatile suspended solids.

Second, to provide for a reduction in the discharge of sulfite waste liquor solids by that degree necessary to achieve the recommended levels of water quality in the Bellingham study area. That is a maximum of 10 parts per million sulfite waste liquor in the surface 50 feet of depth beyond the initial waste dispersion zone.

Third, that they construct a submarine outfall equipped with an adequate diffuser to permit discharge of all residual wastes outside the confines of Whatcom Waterway into a depth of not less than 25 feet, measured at mean lower low water.

Fourth, that they remove, by dredging, the existing accumulation of sludge in the harbor and dispose of this material on land.

Fifth, that they modify their chip-barge unloading operations to eliminate spillage of wood chips.

Recommendations for the City of Bellingham:

First, to provide for collection of wastes discharged by the Fairhaven sewer and other unintercepted discharges.

And second, to provide secondary treatment and effluent chlorination at the present primary plant site with effluent discharge beyond the confines of Whatcom Waterway.

As concerns the City of Bellingham, additional studies are now under way by the Water Pollution Control Commission which are designed to further define the treatment needs. Initial information indicates that primary treatment with effluent chlorination and deep water outfall may adequately protect all other water uses.

This concludes the findings and recommendations for the Bellingham area.

ANACORTES

In the Anacortes study area, the Scott Paper Company pulp mill located in Anacortes is the principal source of wastes now discharged to Guemes Channel. Pulping wastes are pumped to the Channel from the mill site located on Padilla bay. The tidal currents in Guemes Channel provide conditions which are well suited to assimilate residual wastes discharges. However, pulping wastes discharged by the Scott Paper Mill adversely affect water quality in the immediate waste dispersion zone. This effect can be significantly reduced by extending the outfall and diffuser section to a greater depth, thereby providing a greater initial dilution. Settleable solids materials in the waste discharge, some five tons per day, probably do not all settle in the vicinity of the discharge, but are carried to outer channel limits and deposited. Nevertheless, removal of these materials should be a prerequisite prior to discharge to coastal waters.

Fish processing wastes are discharged into Guemes Channel by Fishermen's Packing Corporation and Sebastian Stuart Fish Company on a seasonal basis. The wastes discharged contain significant quantities of settleable solids.

Domestic wastes from the City of Anacortes receive primary treatment plus chlorination prior to discharge into Guemes Channel.

RECOMMENDATIONS

To provide abatement of pollution now

occurring in Guemes Channel and to utilize the Channel's waste dispersal properties, without damage to other uses, the Project makes these recommendations for the Scott Paper Company:

First, that they provide primary treatment of all solids-bearing wastes to obtain removal of all settleable solids and 70 percent removal of volatile suspended solids.

Second, that they extend the present waste outfall line, equipped with an adequate diffuser section, into Guemes Channel to a depth of not less than 50 feet, measured at mean lower low water.

And third, that they provide necessary additional pumping and/or discharge facilities to insure that no bypassing of wastes occur into Padilla Bay.

For Sebastian Stuart Fish Company the Project recommends:

That they provide facilities to discharge all wastes to the City of Anacortes sewer system for treatment at the City's sewage treatment plant.

EVERETT

In the Everett study area, the principal sources of wastes discharged to the Everett Harbor and Port Gardner are the Weyerhaeuser Company sulfite pulp mill and the Scott Paper Company pulp and paper mill. Concentrated pulping wastes from these two operations are discharged through a deep-water outfall to Port Gardner, while large volumes of log-barking, pulp-washing, bleaching, and paper-making wastes are discharged to Everett Harbor immediately adjacent to the two mills. A portion of these latter wastes receive primary treatment prior to discharge.

Our studies have shown that damages resulting from these discharges are again of two types:

Those associated with or caused by the discharge of large volumes of solids-bearing wastes, some 31 tons per day, discharged to Everett Harbor adjacent to the mills. These solid wastes occasionally contain toxic chemicals.

And secondly, there are those damages resulting from the toxic effects of the sulfite waste liquor itself when diluted and dispersed throughout the surface waters of the Port Gardner, Possession Sound, Port Susan and Saratoga Passage.

Specifically, these discharges have been shown to:

One, cause injury or mortality to juvenile salmon migrating through Everett Harbor.

JOHN VLASTELICIA

Two, cause extensive bottom sludge deposits which produce toxic concentrations of sulfides in the adjacent waters. This is damaging to fish and bottom organisms and results in over-all aesthetically unattractive conditions in the harbor.

And three, the wastes have been shown to cause suppression of phytoplankton activity in the Everett Harbor area.

The concentrations of sulfite waste liquor found in the surface waters throughout the study area present an even greater threat to the indigenous marine communities. These wastes in dilute concentrations, again a 5 per 15 parts per million sulfite waste liquor, have been shown to be damaging to larval forms of fish and shellfish found in this area.

The Project studies have shown that such wastes:

Produce damages to developing English sole eggs found throughout the surface waters of Port Gardner and Everett Harbor. Extensive damage or mortality would be expected in and adjacent to Everett Harbor, with the degree of damage decreasing with distance from the waste source.

They have also been shown to produce

extensive damage to oyster larvae. Similar damages would be expected to occur to other indigenous shellfish, as indicated by observed damages to the sessile intertidal organisms.

To prevent additional damages and to provide minimum protection of these organisms during their most sensitive life stages, it again is required that sulfite waste liquor concentrations not exceed 10 parts per million in the surface 50 feet of depth beyond an initial waste dispersion zone. The initial waste disperson zone suggested by the Project is defined as that area of Everett Harbor and Port Gardner enclosed within a one-and-a-half mile radius from the southwestern tip of the harbor. This area encompasses some six square miles.

Wastes from the Simpson Lee Company sulfate pulp mill are discharged into the Snohomish River some 10 miles upstream from its mouth. This mill is relatively small but discharges significant quantities of settleable solids materials that contribute to the extensive bottom sludge deposits found adjacent to the mouth of the Snohomish River.

The City of Everett's domestic wastes are treated in a waste stabilization pond and then discharged into the Snohomish River at a point three and a half miles upstream from the mouth. Bacteriological studies in the river have shown that bacterial concentrations now approach, and at times exceed, those levels recommended by the Washington State Water Pollution Control Commission. Intermittently high bacterial counts have been observed in Everett Harbor.

RECOMMENDATIONS

To provide abatement of the pollution now occurring in Everett Harbor and the Port Gardner system, as just mentioned, these recommendations are made:

For Scott Paper Company five recommendations:

1. Provide primary treatment of all solids-bearing wastes to obtain removal of all settleable solids and 70 percent removal of volatile suspended solids.

2. Provide for a reduction in the sulfite waste liquor solids discharged to and found in the surface waters of the study area. These reductions should be sufficient to achieve the recommended levels of water quality, that is a maximum of 10 parts per million SWL in the surface 50 feet of depth beyond the initial waste dispersion zone.

3. Construct a submarine outfall equipped with adequate diffuser to permit discharge of all residual wastes outside of Everett Harbor.

4. Remove, by dredging, the existing accumulation of sludge in the harbor and dispose of such material on land.

5. Modify chip-barge unloading operations to eliminate all spillage of wood chips.

For Weyerhaeuser Company Sulfite Mill, five similar recommendations:

1. Provide primary treatment of all solids-bearing wastes to obtain removal of all settleable solids and 70 percent removal of volatile suspended solids.

2. Provide for a reduction in the sulfite waste liquor solids discharged to and found in the surface waters of the study area. These reductions again should be sufficient to achieve the recommended levels of water quality.

3. Construct a submarine outfall equipped with an adequate diffuser to permit discharge of all residual wastes outside of Everett Harbor.

4. To remove,by dredging, the existing accumulation of sludge in the harbor and to dispose of this material on land.

And 5, modify chip-barge unloading operations to eliminate all spillage of wood chips.

For the Simpson Lee Company one recommendation, and that is to provide primary treatment of all solids-bearing wastes to obtain removal of all settleable solids and 70 percent removal of volatile suspended solids.

For the City of Everett one recommendation: Washington Water Pollution Control Commission should conduct additional bacteriological studies to determine when chlorination of the City of Everett's waste stabilization pond effluent will be required.

PORT ANGELES

In the Port Angeles area there are two principal sources of pulp mill wastes, the Fibreboard Paper Products Corporation pulp and board mill located on the south shore at the inner end of Port Angeles Harbor, and the Rayonier Incorporated pulp mill located on the south shore at the harbor entrance. Both mills discharge process wastes directly to the harbor surface waters. Of the two mills Rayonier Incorporated is by far the more significant waste source. It contributes about 92 percent of the combined discharges of sulfite waste liquor, COD, BOD_5 and total solids. Wastes from these mills are found throughout Port Angeles Harbor, particularly in the southern portion, and eastward near shore as far as Dungeness Spit, some 12 miles from the harbor entrance.

Another mill, the Crown Zellerbach

Corporation mechanical pulp and paper products mill, located at the inner end of the harbor, discharges its waste directly into the Strait of Juan de Fuca. Except for some transient local collection near the outfall, these wastes generally are dispersed seaward by Strait currents and thus are not predominant in the main study area of the harbor. However, during past years the now-discontinued Crown Zellerbach discharge of high solids wastes into the harbor substantially contributed to a large sludge bed still present at the inner end of the harbor.

Studies have shown that the wastes from these mills are damaging to marine life in the Port Angeles study area. The damages here, as in other areas, are of two types:

One, acute damages occurring within the harbor adjacent to each mill, and mainly associated with the concentrated sulfite waste liquors and settleable solids in the mill effluents.

Secondly, the chronic damages occurring throughout the study area and associated with dilute concentrations of sulfite waste liquor.

Within Port Angeles Harbor waste discharges from Fibreboard and Rayonier produce high waste concentrations, sludge deposits from the discharge of some 21 tons of solids per day, and attendant water quality degradation surrounding each mill source. Also the sludge deposit formed by past Crown Zellerbach discharges continues to seriously degrade water quality adjacent to that mill. Specifically, mill waste discharged into the harbor have been shown to:

One, injure juvenile migrating salmon in the harbor area.

And secondly, form sludge deposits which damage benthic organisms, produce harmful water quality degradation, and result in general aesthetically unattractive conditions.

Of greater importance to marine life in the study area, however, is the presence of dilute sulfite waste liquor in waters throughout the Port Angeles study area from Fibreborad and from Rayonier. Such wastes, even at the low concentrations, 10 parts per million, have been found harmful to immature forms of fish and shellfish. Bioassay studies in the Port Angeles area show that extensive damages occur to oyster larva at waste levels found in surface waters of the harbor and eastward alongshore to Dungeness Spit. On the basis of other bioassay studies reported for Bellingham and Everett it may also be concluded that these waste levels are damaging to a wide variety of important marine life found in the affected portion of the Port Angeles study area, including damages to crabs, clams, sole, cod, anchovy, so forth.

The waste assimilation capacity of Port Angeles study area is seriously limited by the presence of a large slow-moving predominantly anti-clockwise eddy circulation of water between Port Angeles Harbor and Dungeness Spit. This eddy tends to confine Fibreboard and Rayonier mill wastes to shallower waters along shore before eventually dispersing them into the Strait of Juan de Fuca. This results in harmful concentrations of sulfite waste liquor throughout the eddy. Inadequate depth in the eddy area precludes a reasonable relocation of the mill outfalls within the eddy system in order to secure acceptable waste dilution. This is particularly true of the Rayonier mill, because of its large volume of waste discharge.

Therefore, to prevent further damage to the marine resources of the Port Angeles study area it will be necessary to significantly reduce sulfite waste liquors at the source. Minimum protection of the marine biota during their most sensitive life stages requires that sulfite waste liquor concentration again not exceed 10 parts per million in the surface 50 feet of water beyond the initial dispersion zone, and here the initial waste disperson zone suggested by the Project is defined as all that area within Port Angeles Harbor as well as an adjacent area on the east bounded by a one-and-a-half mile radius about Rayonier mill. This disperson zone encompasses about five square miles.

The City of Port Angeles presently discharges all of its domestic wastes untreated into Port Angeles Harbor. As a result, more than two miles of the city's waterfront is bacterially contaminated for water contact use. Also this waste source contributes substantial BOD and settleable solids loading to the harbor. Protection of those persons engaged in contact use of these waters requires immediate abatement of this source of pollution.

RECOMMENDATIONS

To provide abatement of the pollution presently occurring in Port Angeles Harbor and the surrounding area, these recommendations are made.

For Rayonier, Inc., four recommendations:

One, provide primary treatment of all solids-bearing wastes to obtain removal of all settleable solids and 70 percent removal of volatile suspended solids.

Two, provide for a reduction in the discharge of sulfite waste liquor solids by that degree necessary to achieve the recommended levels of water quality in the Port Angeles study area, and that is not to exceed a maximum of 10 parts per million SWL in the surface 50 feet of water beyond the initial dispersion zone.

Three, that they construct a submarine outfall equipped with an adequate diffuser to permit discharge of all residual wastes to a depth of not less than 50 feet measured at mean lower low water.

And four, to remove by dredging the existing accumulation of sludge adjacent to the point of waste discharge and to dispose of such material on land.

For Fibreboard Paper Products Corporation three recommendations:

That they provide primary treatment of all solids-bearing wastes to obtain removal of all settleable solids and 70 percent removal of volatile suspended solids.

Two, that they construct a submarine outfall equipped with an adequate diffuser to permit discharge of all residual waste to a depth of not less than 50 feet measured at mean lower low water.

And three, to remove by dredging the

existing accumulation of sludge in the harbor adjacent to the point of waste discharge and to dispose of such material on land.

For Crown Zellerbach Corporation three recommendations:

Again provide primary treatment of all solids-bearing wastes to obtain removal of all settleable solids and 70 percent removal of volatile suspended solids.

Construct a submarine outfall to permit discharge of all residual wastes to a depth of not less than 30 feet measured at mean lower low water in the Strait of Juan de Fuca.

And three, to remove by dredging the existing accumulation of sludge adjacent to the mill in Port Angeles Harbor and to dispose of such material on land.

The City of Port Angeles, one recommendation, and that is to provide for the collection of all domestic wastes discharges and primary treatment and effluent chlorination with discharge through a deep diffuser outfall.

The proceedings thus far this morning have briefly stated the work and findings of the Washington State Enforcement Project. The areas, the studies, the results and recommendations of the Project, as Mr. Kari mentioned this morning, are given complete and comprehensive treatment in our final report. This report has already been made part of the record and it is entitled "Pollutional Effects of Pulp and Paper Mill Wastes in Puget Sound." This report is commended to the attention of those of you interested in Project details beyond those which we have presented this morning, and as earlier mentioned, copies of this report are available at the State Water Pollution Control Commission's office in Olympia and the Federal Water Pollution Control Administration's office in Portland. A limited number of these reports will be available at the back of this room later in the day.

Mr. Chairman, this concludes this portion of our presentation. Mr. Kari has a brief summary to present.

CHAIRMAN STEIN: In order to save a little time and for the purpose of clarification, while you are up here, may I ask one question?

On page 23 of your report concerning the Anacortes area, you talk about fish processing wastes that are discharged by Fishermen's Packing Company and Sebastian Stuart Fish Company. Then on Page 24 you have recommendations for Sebastian Stuart Fish Company only and none for Fishermen's Packing Corporation. Why is that?

MR. VLASTELICIA: Mr. Kari?

MR. KARI: I think it was an oversight, Mr. Stein.

CHAIRMAN STEIN: As you can readily appreciate, I am not asking any probing questions at this time. But before we complete the record, I suggest for clarification only that you consider getting that in. We will hold the record open for it.

Thank you.

(The following was subsequently provided for the record by Mr. Kari: Fishermen's Packing Corporation shall provide facilities to discharge all wastes to the City of Anacortes sewer system for treatment at the City's sewage treatment plant.

MR. VLASTELICIA: Mr. Kari.

STATEMENT OF EARL N. KARI
OF THE
FEDERAL WATER POLLUTION CONTROL COMMISSION

MR. KARI: Thank you, Mr. Vlastelicia.

SUMMARY

You have heard a rather complete summary of studies made in following through on the recommendations of the 1962 Conference to determine the pollutional effects of pulp and paper mill wastes in Puget Sound. Four years of intensive and objective studies have produced the most thorough analysis yet made of the effects of sulfite pulp mill wastes on marine life and the environment. These studies demonstrate that untreated sulfite mill wastes have caused, and continue to cause, substantial damage to the Puget Sound fisheries, including both the shell and fin fish and the marine environment on which these fisheries depend.

If we intend to abate pollution in Puget Sound so that these waters will be suitable for all uses to which they are put, then all damaging wastes, industrial and domestic, must be subjected to treatment. The people of the pulp and paper mill communities have recognized this fact. These communities provide generally acceptable waste treatment facilities, except for the City of Port Angeles where construction of a primary treatment facility is now pending.

The day has passed when untreated or inadequately treated man-produced wastes are discharged wholesale into public waters with damaging effects. We can protect the environment for shellfish if the waters of Puget Sound contain not more than 10 parts per million of sulfite waste liquor. This will also protect and preserve the aquatic environment for indigenous fin fish.

Since the study recommends that these requirements need not be met in certain limited areas near pulp and paper mill outfalls, this remedial program, it is believed, will be capable of accomplishment by the pulp and paper mills within existing resources and technology. With this program we can have fin and shellfish and the pulp and paper industry side by side in the Puget Sound area. The water quality conditions prescribed above will permit both to grow and expand and provide a unique recreational resource for the people of Washington.

The specific treatment needed for the wastes from these seven Puget Sound sulfite pulp mills is set forth mill by mill in the recommendations you have heard. The gross discharge of some 72 billion gallons a year of largely untreated wastes equivalent to a raw discharge from 12 million people must be subjected to treatment.

New industries are being directed by most states to provide a degree of treatment that will protect all legitimate water uses. These new industries are complying with these directives and installing sophisticated waste treatment facilities. Examples of this enlightened industry response are found at the Kimberly-Clark mill in California, the Weyerhaeuser mill in Oregon, and the Kamloops mill in British Columbia.

For the most part, sulfite pulp mills are older mills which are few in number. There are some 365 pulp mills in the United States. Only 55 of these use the sulfite process, with nearly one-fourth of these being in the State of Washington.

Sulfite pulp mill wastes are amenable to treatment. There is no technological barrier to the elimination of sulfite waste discharges. Where damages prevail from untreated sulfite mill wastes, as demonstrated by this study of the seven Puget Sound pulp and paper mills, adequate treatment works should be built and placed in operation without any undue delay.

There is no other choice if pollution is to be prevented and the quality of Puget Sound waters enhanced. It should be our goal for the protection of future generations who will wish to use and enjoy this valuable resource.

Thank you, Mr. Stein.

CHAIRMAN STEIN: Thank you, Mr. Kari.

MR. POSTON: Mr. Chairman, this concludes the Federal Water Pollution Control's presentation and I would hope next to call upon other Federal agencies, but I think in view of the time I will turn the meeting back to you.

CHAIRMAN STEIN: Thank you.

Right now we would have two proposals, one to permit comments and questions on the report. And I might indicate, not just for the representatives of the State of Washington, but others here, we have assembled in the room, as we generally do at these conferences, a large variety of experts. So if we have any questions that have to be clarified, we can call on them.

Do you have any comments at the present time or questions or do you want to consult with your staff first?

MR. HARRIS: I would suggest that be deferred until after the lunch break.

CHAIRMAN STEIN: With that, we will plan on recessing for lunch.

This afternoon what will be on tap are comments and questions by the Conferees on the Federal report, and I believe Mr. Poston has statements, relatively short statements, I think, from two Federal agencies. Then the time will be turned over to the State of Washington for its presentation and its Invitees and we will continue hearing as many people as we possibly can hear today.

If any of the people in their presentation would want any material clarified which came up before, please do not hesitate to bring that point up and we will attempt to have the Project Commission or Mr. Poston produce the expert or the specialist in that area and perhaps he can answer your question. I think this might move the issue or the case to solution in a more rapid manner.

With that, we will stand recessed for lunch until 1:45.

(NOON RECESS)

AFTERNOON SESSION

CHAIRMAN STEIN: May we reconvene.

Are there any comments or questions on the Federal report? Mr. Poston.

MR. POSTON: I wonder if Mr. Kari can answer our question at this time about Sebastian Stuart Fish Company at Anacortes?

MR. KARI: We are still checking on that.

MR. POSTON: Still checking on it?

CHAIRMAN STEIN: When you get the information, let us know.

MR. KARI: Right.

MR. POSTON: If Mr. Harris has no questions, I will proceed to the calling--

CHAIRMAN STEIN: Let's ask Mr. Harris.

MR. HARRIS: I would like to state at this time that I have no basic questions. I would like to read a statement into the record a little bit later.

CHAIRMAN STEIN: Thank you, Mr. Harris.

We will now have the other Federal agencies. Mr. Poston?

FEDERAL PRESENTATION (continued)

MR. POSTON: I would like first to call upon our colleague from the Department of Interior, Mr. John Glude, of the Bureau of Commercial Fisheries, who was here this morning and who has a statement for us.

STATEMENT OF JOHN GLUDE
OF THE
BUREAU OF COMMERCIAL FISHERIES

MR. GLUDE: Mr. Chairman, Conferees, ladies and gentlemen.

I would like to make this statement for the Pacific Northwest Region of the Bureau of Commercial Fisheries. My name is John Glude and I am a Deputy Regional Director.

The fish and shellfish produced within the U. S. territorial and fisheries limits are of great importance to the people of the United States. These products are used for human food, industrial products, and in the nutrition of animals which are subsequently used for human food.

The per capita utilization of all fishery products continues to rise, and during the period 1950 to 1964 increased 50 percent.

The population trend in the United States continues upward and the demand for fishery products will also rise. An estimate based on conservative projections of population, income, and per capita consumption indicates that the total consumption of fish and fish products in the United States will increase a minimum of 75 percent from the current 12-billion pound level to 21 billion pounds by the year 2000. If one takes into consideration the anticipated increase in income in the future, improvements in the marketing and distribution system, the development of new products, improved quality and consumer education, a realistic estimate of consumption of fishery products increases to 27.8 billion pounds by the year 2000. This is about 130 percent of the present consumption.

Many experts have attempted to estimate the potential world yield of marine fishery products, and conservative figures show that we are presently utilizing only a minor portion of the resources of the sea. But these estimates, however, do not take into account the consumer acceptance of species not presently utilized, nor do they consider the geographical distribution of these resources.

We have already experienced intensive foreign competition for fishery resources along our coast, it has been pretty apparent in the last couple years. We are very aware of the difficulty of competing against the huge government-controlled fleets of foreign nations. We are becoming increasingly aware of the importance of maintaining and developing fish and shellfish production within our territorial waters where we can avoid the problem of international competition.

We are most concerned, therefore, that the fish and shellfish resources of Puget Sound and other inshore waters be fully utilized and that the quality of the environment be protected so that the production of these valuable species can be maintained.

It is even more important, in anticipating future demand for fishery products, that the potential for increasing production of inshore waters be recognized. New improved methods of increasing production of fish and shellfish are being developed, and many of these can be applied in Puget Sound. It would be shortsighted to sacrifice marine areas on the basis that they are not presently being utilized for the production of fish or shellfish. Indeed, we would be wise to improve the quality of the marine environment in anticipation of a time in the future when much of this area will be needed to produce food to meet the needs of our expanding population.

We have followed with much interest the studies during the past five years to investigate the pollutional effects of pulp and paper mill wastes in Puget Sound. We have met periodically with the various individuals and the groups involved in these studies and we reviewed the final report which they published in March of this year.

In our opinion, this report presents an excellent study of an extremely complex problem. The research methods used were generally appropriate and the analysis of results was well documented. The investigators utilized talents of State and university scientists in the Pacific Northwest in the conduct of portions of the studies and in the planning of experiments and the statistical analysis of the results.

The report presents solid scientific evidence of water pollution and its cause in the study areas. The variety of observations and analyses, and the extended period covered by the study strengthen the conclusions. In our opinion, the report provides a factual basis for recommended actions which will be necessary to reduce pollution in these areas to acceptable levels.

We are concerned that the studies may not have gone far enough in identifying the deleterious effects of low concentrations of the pollutants. For example, short-term experiments demonstrated that juvenile salmon were killed when subjected to high concentrations of sulfite waste liquor, or to adverse conditions resulting from sulfides released by sludge beds, but there was no evaluation of long-term effects of less drastic conditions.

In recognition of this deficiency in the study we would recommend additional research to investigate this aspect of the problem. We would also recommend that any pollution abatement procedures be considered as minimum measures, with the understanding that it may be necessary to further reduce levels of pollution in the light of future research.

The same criticism applies to studies of the effect of the pollutants on oysters and other molluscan shellfish. Long-term effects of low concentrations of wastes on growth rate and fatness have not been thoroughly investigated in this study. This area requires further research. It may be necessary to amend standards of water quality when additional knowledge provided by such experiments becomes available.

We are also concerned that these studies have not taken into account the changes in water quality which may result from planned industrial installations in or near the study areas. For example, in a recent study by Battelle Northwest regarding siting of nuclear power plants in the Pacific Northwest, locations on Whidby Island, on the Straits of Juan de Fuca, and near Bellingham were recommended. The 1,000 megawatt thermal electric plants considered in the Battelle report utilize 2,000 cubic feet per second of water for cooling the condensers, and this increases the temperature of the water thus utilized by 16 degrees Fahrenheit. Major water temperature increases are expected at or near the outfall areas and minor increases would be detectable for some distance from the outfall plume, depending upon tidal circulation. Thus temperature of the salt water will become an important variable to consider in the Puget Sound area in the not too distant future.

At this very moment, fisheries agencies are facing problems of thermal pollution in the Columbia River, since increases in water temperature can cause detrimental effects on production of salmon. The Columbia River is slowly becoming marginal for the production of salmonids, and water temperature plays a critical role in this relationship. Hydro impoundments in this area have reduced velocity of flow and have increased surface acreage exposed to solar radiation. Increases in water temperature during the summer months has resulted.

It is stongly suspected that the synergistic effects of wasted heat from the Hanford complex on sublethal and lethal concentrations of nitrogen gas produce a wholly undesirable situation for migrating salmonids.

JOHN GLUDE

The problem of thermal pollution may be further complicated by the installation of three more thermal (nuclear) electric plants on the Columbia River from Hanford to Longview, Washington by 1985. The three sites selected have been recommended for development from 3,000 MW initially to 9,000 MW when completed. If direct cooling of the condensers by river water is carried out at these plants, some 6,000 to 27,000 CFS of water could be utilized at some future date.

We are concerned that any thermal electric plants that are installed in the future in the Columbia River would increase the detrimental effect to both commercial and non-commercial species of fish. Research is now under way to establish a description of the problem at each potential site.

In the marine environment, an increase in temperature in areas where there are layers of sludge could cause an increase in the production of toxic sulfides. This could aggravate an already serious condition at several locations within the study area. It is important, therefore, to take into consideration the effects of changed temperature and other factors such as this. It does not appear that this aspect has been adequately covered in the report.

There remains the possibility that changes in temperatures could have a beneficial effect on the production of shellfish in the study areas. The introduction of thermal electric plants could increase water temperature to a degree that would improve the chances of successful reproduction and make these areas even more valuable for culture of shellfish. The opportunity to modify the environment in a favorable direction must also be recognized in the planning for industrial developments.

In summary, the deficiencies of this report are that the investigators have not gone far enough in identifying toxic effects of low concentrations of pollutants over long periods of time, nor have they considered the effects of other industrial developments planned for these areas. Nevertheless, the studies provide a sound basis for interim measures which will greatly improve the existing situation.

The recommendations included in the report are well founded and appear feasible. We would urge their adoption as minimum measures necessary to protect the marine environment in the study areas.

Thank you.

CHAIRMAN STEIN: Thank you, Mr. Glude. Are there any comments or questions?

As I understand the thrust of your statement, you have concluded that the investigators in the Federal Water Pollution Control Agency have come up with what might be the irreducible minimum, and you want them to go farther?

MR. GLUDE: Yes, we do.

CHAIRMAN STEIN: We have been working very closely with the Fish and Wildlife Service, especially since we have been in the Department of the Interior. As a matter of fact, next week I am going out to Chicago with Mr. Poston's distinguished brother, who is the Regional Director in Chicago, working on the Alewife, and we would hope that the key representative there of the Department of Interior will be a member of the Bureau of Commercial Fisheries. As a matter of fact, we expect Dr. Smith to be out.

More and more as we work on these problems I think we have to recognize a close relationship with the Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife and the Bureau of Commercial Fisheries,and I think your own point is well taken. We have a proposed study in Maine now on the production of lobster. Evidently the mean temperature in the Maine waters has dropped seven degrees over the past several years for reasons unknown to us. We do have a power generator on an island in Casco Bay off Portland, and the notion was that we would see if we could heat up some of the water--whether that may bring the lobsters to maturity. I know you people here are so involved with your own indigenous fish that you probably haven't been keeping track of eastern lobster prices, but they have gone up and up, and the problem is, with these cold waters, the lobsters take many more years. With the reduction in temperature they take many more years to arrive at maturity and the prices have gone up.

So I think when we deal with a problem such as thermal pollution, this may work two ways. In some areas, as you very well point out in your report, this may be an advantage.

The problem that we have been faced with with fisheries is that for the most part, and this may be a little different with the oysters, the fisheries have not been a managed resource the way we manage agricultural products. It is generally a harvesting of a wild resource, a little more sophisticated, except in methods of capture, than the pioneers used to do when they used to trap or hunt game.

In addition to the problems you point out that we definitely have with these government-subsidized fleets from other areas which have to increase the harvest from the marine environment or really face severe economic problems, the notion is that if we can get our fishery resource to be managed as scientifically as we do some of our other food products, we can greatly increase the area of productivity.

Again,as Mr. Glude points out,one of our greatest resources is Puget Sound. These are clearly American waters, these are clearly within our province, and anything we can do here can be not only a great economic benefit to the region, but a great economic benefit to the country as a whole.

Are there any further questions or comments? Do you want to say anything?

MR. GLUDE: Thank you very much for your comments. I certainly agree with you. We have seen the extremely serious pollution in Lake Erie, some other places, places in the world that we never even think of as being serious. I had a discussion with the Swiss consulate recently, and even in Switzerland, we think of the Alps as being free and pure, free from pollution, yet even there there are extremely serious problems in pollution. I think we should recognize the serious problems that can develop in the future.

Those of us who have seen the East Coast recognize it. We are proud of the clean water in Puget Sound and, of course, we would like to keep it that way.

CHAIRMAN STEIN: Right.

Let me go off the record a second.

(Off the record.)

CHAIRMAN STEIN: Now, I recognize this is not going to be easy. I recognize that sometimes when we speak of tremendous expenditures of funds and we talk about hundreds of millions of dollars and these are public expenditures of funds, you have one thing, but I also recognize when we speak in terms of millions of dollars and these may be private funds or industrial funds that have to be spent that in the long range this may be the best thing that we can all do for our own self interest as well as the national interest to move ahead with the problem.

For example, in the Great Lakes, the big industries there are the petroleum industry, the petrochemical industry, and the steel industry. I think both of these industries recognize that the preservation of the Great Lakes as a natural water resource is essential to the maintenance of the industry, and these private firms have spent the money to do the job.

I do think in the same way here, there is no industry more dependent upon the clean water in their product than the pulp and paper industry. As much as timber or any of the other products you have, water is your essential raw material. And I think the interest of the industry does not differ from the interests of the fishery people, of the water pollution control people, I might say even shellfish or oyster or fishery people or the municipal people or the people here who want to use this as a recreational resource. We all have the same objective, and if we regard water as a natural resource and a raw product in the industry the same as we regard timber or labor or power, I think we will be far ahead.

I was at a meeting of the Pulp and Paper

Association--they always have a good one; they have it at the Waldorf Astoria in New York--a year or two ago, and the president of the association then said if the people in our industry gave as much thought to pollution control and the mill managers as they do to providing parking space for the employees, maybe we would be way ahead. (Laughter) That is not my quote. I am quoting the president of the Pulp and Paper Association.

Thank you.

MR. GLUDE: Thank you.

CHAIRMAN STEIN: Mr. Poston.

MR. POSTON: Thank you, John.

Until FWPCA was put in the Department of Interior, the newest agency in that group was the Bureau of Outdoor Recreation, and today to present a statement we have their Regional Director, Mr. Fred Overly.

STATEMENT OF FRED OVERLY
OF THE
BUREAU OF OUTDOOR RECREATION

MR. OVERLY: Mr. Chairman, ladies and gentlemen.

The Bureau of Outdoor Recreation is not a land managing agency. Its responsibilities are to provide a focal point and leadership in the nationwide effort to meet the demands for outdoor recreation through:

FRED OVERLY

Planning which will identify actions needed to protect the natural beauty of the outdoor environment and to provide outdoor recreation resources to meet the variety and diversity of needs of the American people.

Promoting coordination of Federal plans and programs relating to outdoor recreation and preservation of natural beauty.

Assisting Federal, State, local and private efforts to reclaim and protect the outdoor environment and provide outdoor recreation opportunities.

The Bureau's functions are authorized principally by three statutes and an Executive Order:

Public Law 88-29, the Bureau's Organic Act;

Public Law 88-578, the Land and Water Conservation Fund Act of 1965;

Public Law 88-72, the Federal Water Projects Recreation Act of 1965; the Executive Order 11278 of May 4, 1966; establishing the President's Council on Recreation and Natural Beauty and a Citizen's Advisory Committee on Recreation and Natural Beauty.

These authorize the Bureau to prepare and maintain a continuing inventory and evaluation of the Nation's outdoor recreation needs and resources; formulate and maintain a comprehensive nationwide outdoor recreation plan; provide technical assistance to and cooperate with States, their political subdivisions, and private outdoor recreation interests; sponsor, engage in, and assist in outdoor recreation research; promote coordination of Federal outdoor recreation plans and activities; administer a program of financial assistance to the States, and through States to local public agencies, for planning, acquiring and developing public outdoor recreation resources; coordinate a program of recreation land acquisition by the National Park Service, Forest Service and Bureau of Sport Fisheries and Wildlife; provide outdoor recreation planning assistance at Federal water projects; provide the Executive Director to the President's Council on Recreation and Natural Beauty.

In carrying out these responsibilities the biologic, chemical and aesthetic quality of water is an important consideration. Water-oriented recreation is significant nationwide and especially so in Puget Sound.

We are currently engaged in a study of the recreation aspects of the water resources of the Puget Sound region. We have learned for a single example that there are over 186,000 pleasure boats using Puget Sound and adjacent waters.

We operate on the principal that high

quality water is basic to the maintenance of an attractive environment and to recreation. The environment we enjoy in Puget Sound is exceptionally fine, but not as fine as in yesteryear. There are all kinds of reasons for this, including more people and more industry. However, it is worthwhile to note that the economy and industry itself are helped tremendously by an attractive environment. Recreation is a major economic force in Puget Sound and in addition the opportunity to enjoy outdoor recreation is a major factor in attracting a technical and labor force to the northwest. The attractive water and countryside are widely and well known.

Our Bureau is gathering and developing valuable recreation data that we will make available to you should this be needed in your deliberations.

I wish to put before you our concern that the value of recreation as a social and economic good, taken with our concern for aesthetically pleasing waters, are worthy of your special attention. As you consider the pollution of the navigable waters of Puget Sound, the Straits of Juan de Fuca, their tributaries and estuaries, I am hopeful that outdoor recreation and aesthetic considerations will carry considerable weight.

CHAIRMAN STEIN: Thank you, sir. Are there any comments or questions?

If not, thank you very much for your statement.

MR. POSTON: Thank you, Fred.

I believe we also have in the room Mr. William J. Beck, who is representing the Department of Health, Education and Welfare.

STATEMENT OF WILLIAM J. BECK
OF THE
DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

MR. BECK: Mr. Chairman, Conferees, ladies and gentlemen.

My name is William J. Beck and I am Chief of the Pacific Northwest Marine Health Science Laboratory, Gig Harbor, representingthe part of the Public Health Service of the Department of Health, Education and Welfare. We are the ones who were left when everybody else went to the Interior.

This morning you noted several instances of raw domestic sewage being poured into the Puget Sound area which we believe could be potential health hazards, both as sources of pathogenic microorganisms, as well as human toxicants from other sources noted. Unfortunately, and being a researcher I can say this, our technology of detection is not up even as far as the Pearl-Benson method for SWL. Therefore, our knowledge of what these effects are is very limited.

However, we know from various other studies that we have potentials such as vibrio paraheamolyticum, clostridia, enteric bacteria, viruses, carcinogenic substances that could be utilized in these areas.

On the second part is the cumulative effects, as was mentioned by Mr. Glude, that we are now faced with the potential of thermal pollution as well as pollution from wastes and other toxicants. This cumulative effect could be very dangerous and very hazardous, because many of the things that are associated with certain of these wastes could be utilized as nutrients for some of the pathogenic microorganisms. For example, at one time SWL was considered as a very good media for torula yeast, which is in the fungi group, and I don't think there are more than two micrologists in the world today who are even studying fungi in the estuarine area.

We accepted those as proposed in this study as a long step forward in removing potential pollution sources that could be considered as potential public health problems.

Thank you.

CHAIRMAN STEIN: Thank you, Mr. Beck. Any comments or questions?

If not, thank you very much.

Mr. Poston.

MR. POSTON: Our office notified all Federal agencies of this Conference today. Those people I have called on have indicated their desire to make a presentation. There may be others in the room. If so, at this time I will call on them to come forward and make themselves known, present their statement.

STATEMENT OF NORMAN J. MAC DONALD
CHIEF, WATER CONTROL
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

MR. MacDONALD: Mr. Chairman, Conferees, and ladies and gentlemen.

I am Norman J. MacDonald, representing the Seattle District Office, Corps of Engineers, and the North Pacific Division Office, Corps of Engineers.

We have no formal presentation to make, but I felt that since opportunity was given, if we didn't say something it may be an indictment against our interest in water quality control. This would be unfortunate in view of some of the criticism nationwide on some of the Corps of Engineers' activities in dredging, and I believe that in this particular area that is under consideration today the Corps of Engineers does have a vested interest. We are often criticized for the spoil which we throw up when we go into our dredging operations, and I believe that with proper control of some of this effluent it will make it much less critical in our operation if we do not have these sludge deposits on the bottom. And so from that standpoint, we would be very much interested in the control of these effluents.

Another area where we would be interested would be in the area of permits. Any work which is to be undertaken in navigable waters requires a permit from the Corps of Engineers, and just recently we have entered into an agreement with the Department of Interior, FWPCA, to become involved with them prior to issuing a permit to see to it that anyone who is given a permit will live within the water quality standards adopted primarily by the State agencies involved, and since some of these permits may be issued for areas involved in the study, it would make it much easier in the issuing of permits and for contractors and others to live up to requirements if these sludge deposits could be held to a minimum and if, as a matter of fact, they could be eliminated.

So again I would like to say that we do have a distinct interest in the water quality of Puget

Sound and the estuaries and the rivers that discharge into Puget Sound, we have a great deal of interest in water resource development. In any of these studies we immediately contact FWPCA and through them the State to get their comments with regard to the development of the resource for pollution abatement, low flow augmentation, and so on, and our interest, therefore, is considerable in this particular field.

And so I thought it appropriate to make just this general comment concerning our interest so that you could see we do have an area of involvement in the particular environment that is under discussion today and tomorrow.

Thank you.

CHAIRMAN STEIN: Thank you, Mr. MacDonald.

Any comment or questions?

The Corps, as you know, is one of our sister agencies with whom we work very closely.

Mr. Poston.

MR. POSTON: Are there other Federal agencies who wish to be heard at this time?

I guess the answer is negative.

Mr. Chairman, this concludes the Federal presentations, except for the furnishing of the material on the Sebastian Stuart Fish Company at Anacortes.

CHAIRMAN STEIN: Thank you.

At this time we will call on Mr. Harris for the State of Washington.

Mr. Harris.

STATE PRESENTATION

STATEMENT OF ROY M. HARRIS, DIRECTOR
OF THE
WASHINGTON STATE WATER POLLUTION CONTROL COMMISSION

MR. HARRIS: My name is Roy M. Harris. I am the Director of the Washington State Water Pollution Control Commission, and the statement that I am presenting today represents the detailed and critical staff review of our Commission staff members.

This subject report has been reviewed in considerable detail, and in general we believe the information and data presented in the report describes water quality in the study areas and links the major source of pollution to pulp and paper mills. We also generally concur with the treatment requirements for the pulp and paper mills covered in the report, although some of the recommendations we believe have need for rewording and clarification.

The report recommends that all wastes be given a minimum of primary treatment to achieve: (a) removal of all settleable solids, and (b) removal of a minimum of 70 percent of all volatile suspended solids in the total mill effluent. We fully support the general concept of primary treatment for all wastes, but do not believe that the 70 percent removal of volatile suspended solids is achievable at all mills with standard primary treatment. In addition, the report does not document the 70 percent removal requirement for volatile suspended solids as being necessary toachieve a particular water quality in the waste discharge area.

For example, this requirement can be easily met by Crown Zellerbach, Simpson-Lee, Scott at Anacortes, and Rayonier, but cannot be easily met by Georgia-Pacific and Weyerhaeuser without the use of settling aids. For example, Georgia-Pacific presently has a suspended solids loss of 43 pounds per ton of production. After primary treatment, the loss should be 19 pounds per ton or a reduction of 59 percent. Rayonier loses 70 pounds per ton at present, but after primary treatment should lose approximately 21 pounds per ton for a reduction of 71 percent.

So we prefer to require primary treatment for removal of all settleable solids and to base the clarifier designs upon well-established, conservative design criteria.

The report recommends that all mills provide for improved outfalls except Simpson-Lee. The report also states the minimum depth at which each particular mill outfall should be located. We believe that the outfall is a very necessary part of any waste treatment system, but that the outfall should be located and designed to achieve maximum dilution and dispersion of the waste, based upon an engineering study of the receiving watercourse.

The report makes recommendations for domestic waste treatment at the municipalities of Bellingham, Everett, and Port Angeles, as well as for several small industrial waste dischargers at Bellingham and Anacortes. The recommendations are in concurrence with our Plan of Implementation which has been submitted to the Federal Water Pollution Control Administration, with the exception of Bellingham. The report states that secondary treatment is necessary at Bellingham, while our plan states that a minimum of primary treatment is required and additional treatment may be required based upon a study by the City. The report does not document the need for the higher degree of treatment, but we prefer to use the method as outlined in our Plan of Implementation.

The report recommends that dredging and removal of sludge deposits from areas adjacent to mill outfalls at Whatcom Waterway and Bellingham Bay, Everett Harbor, and the Port Angeles Harbor be performed by the mills. The report supports this recommendation by demonstrating acute toxicity to test fish due to hydrogen sulfide released from the sludge beds. We support this recommendation.

The report recommends that Georgia-Pacific, Scott Paper and Weyerhaeuser at Everett modify chip barging unloading operations to eliminate spillage of wood chips. We support this recommendation.

We do, however, suggest that the recommendations in the report be modified to read as follows:

BELLINGHAM AREA

Georgia-Pacific Pulp, Board, and Paper Mill:

And I shall add here to the numbers in the report as the same numbers here.

Recommendation 1. We suggest it be modified to provide for primary treatment of all solids-bearing wastes for removal of all settleable solids prior to discharge into Bellingham Bay.

Recommendation 2. We have no change suggested.

ROY M. HARRIS

Recommendation 3. Modified as follows:

Construct a submarine outfall equipped with an adequate diffuser to permit discharge of all residential wastes outside the confines of Whatcom Waterway and located in the deeper water of Bellingham Bay to achieve maximum waste dilution and dispersion.

With recommendations 4 and 5 we concur.

CITY OF BELLINGHAM

Recommendation 1, the same.

Recommendation 2, modified as follows:

Construct a submarine outfall from the present primary plant into the deeper water of Bellingham Bay to achieve maximum waste dilution and dispersion.

And under the City of Bellingham we wish to add or suggest the addition, rather, of Item 3:

Conduct an engineering study to determine whether a higher degree of treatment than primary treatment will be necessary to comply with receiving water standards.

ANACORTES AREA

Scott Paper Company:

Item 1, modified as follows:

Provide primary treatment of all solids-bearing wastes for removal of all settleable solids.

Item 2 to be modified as follows:

Extend the present outfall line, equipped with an adequate diffuser section, into the deeper water of Guemes Channel to achieve maximum waste dilution and dispersion.

Item 3, same.

EVERETT AREA

Scott Paper Company:

Item 1,modified as follows:

Provide primary treatment of all solids-bearing wastes for removal of all settleable solids prior to discharge into Port Gardner Bay.

Item 2, the same.

Item 3, modified as follows:

Construct a submarine outfall equipped with an adequate diffuser to permit discharge of all residual wastes into the deeper waters of Port Gardner Bay to achieve maximum waste dilution and dispersion.

Item 4 and Item 5, the same.

Weyerhaeuser Company Sulfite Mill at Everett:

Item 1, modified as follows:

Provide primary treatment of all solids-bearing wastes for removal of all settleable solids prior to discharge into Port Gardner Bay.

Item 2, the same.

ROY M. HARRIS

Items 3, 4 and 5, the same.

Simpson-Lee at Everett:

Item 1, modified as follows:

Provide primary treatment of all solids-bearing wastes for removal of all settleable solids prior to discharge into Snohomish River.

Item 2 is a suggested new recommendation:

Elimination of waste overflows into bypass sewer.

Item 3 is a proposed new section:

Construct a submerged outfall equipped with an adequate diffuser to permit discharge of residual wastes into the Snohomish River to achieve maximum waste dilution and dispersion.

For the City of Everett:

Modify Item 1 as follows:

Provide chlorination for waste stabilization pond effluent.

PORT ANGELES AREA

Rayonier:

Modify Item 1 as follows:

Provide primary treatment of all solids-bearing wastes for removal of all settleable solids prior to discharge into Port Angeles Harbor.

Item 2, the same.

Item 3, modify as follows:

Construct a submarine outfall equipped with an adequate diffuser to permit discharge of all residual wastes into the deeper waters of Port Angeles Harbor in order to achieve maximum waste dilution and dispersion.

Item 4, no change.

Fibreboard Paper Products at Port Angeles:

Item 1, modified as follows:

Provide primary treatment of all solids-bearing wastes for removal of all settleable solids prior to discharge into Port Angeles Harbor.

Item 2 to be modified as follows:

Construct a submarine outfall equipped with an adequate diffuser to permit discharge of all residual wastes into the deeper waters of Port Angeles Harbor to achieve maximum waste dilution and dispersion.

Item 3, no change.

Crown Zellerbach at Port Angeles:

Item 1, modified as follows:

Provide primary treatment of all solids-bearing wastes for removal of all settleable solids prior to discharge into the Strait of Juan de Fuca.

Item 2 to be modified as follows:

Construct a submarine outfall to permit discharge of all residual wastes into the Strait of Juan de Fuca to achieve maximum waste dilution and dispersion.

Item 3, no change.

For the City of Port Angeles, to be modified as follows:

1. Provide for collection of all domestic waste discharges and treatment of these wastes by providing primary treatment and effluent chlorination with discharge into deep water diffuser outfalls.

Mr. Chairman, that concludes the statement I wish to make on behalf of our staff review.

CHAIRMAN STEIN: Are there any comments or questions?

MR. POSTON: I have none.

CHAIRMAN STEIN: Mr. Harris, I think, as far as I could see, those are very constructive suggestions. You know, the lawyers always like to quibble, but you engineers take the cake. (Laughter) I think that this is a field day for engineers. I don't believe that the recommendations that you have made and the recommendations of the staff of the Federal Water Pollution Control Administration are so far apart that they can't be adjusted with a reasonable amount of adjudication.

I just have one question. This is really, you know, just an information question.

When you talk about Port Angeles, you talk about primary treatment and disinfection. Did you mean that for Bellingham, too, that they have to disinfect the wastes if they are going to have primary treatment?

MR. HARRIS: We require disinfection for all municipal districts.

CHAIRMAN STEIN: Right.

MR. HARRIS: Does that answer your question?

CHAIRMAN STEIN: Yes, it surely does.

These points are very detailed, and if you disagree with me, Mr. Harris, I would like to know. But I do not think that the differences in the suggestions are really significant or amount to anything that can't be adjusted by the technical staffs.

MR. HARRIS: I am sure they can. In fact, some people might call it nit-picking.

CHAIRMAN STEIN: Right. Well, I don't know, I think it is an improvement. I have always felt in the Government that when someone wrote a report and I couldn't improve on the first draft, maybe I was slipping. But if I wrote it first, I would expect them to improve on it. And I am not sure that given the basic report that the Federal staff has worked up but what some of the refinements and suggestions that you have made are not very pertinent and should be given serious consideration. I have no doubt that the differences are not so great that the State of Washington and the Federal Government will not be able to achieve unanimous agreement as they have in the past.

Thank you.

MR. HARRIS: As I stated originally, we have no general disagreement.

CHAIRMAN STEIN: I don't think there is disagreement.

Thank you.

FROM THE AUDIENCE: Mr. Stein, could I ask Mr. Harris a question?

CHAIRMAN STEIN: I would suggest that we reserve that until you make your statement. Any of the statements that you have, part of your statement can be directing a question to Mr. Harris or any other of the Conferees or any of the experts we have.

Our problem is this. If we throw the meeting open to questions, we will be here for weeks. I want to assure you that any pertinent question will not be unanswered, you will be given the floor and be given an opportunity. Let's try to proceed if we can.

Mr. Harris.

MR. HARRIS: At this time I should like to call on a representative of the State Department of Health to present a statement on behalf of that agency.

STATEMENT OF JAMES C. PLUNTER
HEAD, SANITARY ENGINEERING SECTION
WASHINGTON STATE DEPARTMENT OF HEALTH

MR. PLUNTER: Thank you, Mr. Chairman. Members of the Conference and ladies and gentlemen.

My name is Jim Plunter, and I represent the Washington State Department of Health.

The technical questions under study at this hearing are undeniably complex. We claim no expertise in the field of industrial waste. Our concern and responsibility is the preservation, the protection, and promotion of the health and well being of the people of the State, and as such, our position is simply stated.

We are committed to keeping the total environment, including water, as clean as possible, as free of contaminants or pollutants or foreign materials as is technologically feasible.

We believe this is a sound principle which will aid substantially in protecting public health and assuring the preservation of the environment for future generations.

Therefore, we support the investigation described this morning and the recommendations made.

With regard to the recommendations for improvements to treatment of municipal waste in the study areas, we agree that improvements are needed here, as in other communities in Puget Sound and throughout the State. The Department has so stated at water quality hearings conducted over the past year by the Washington Water Pollution Control Commission. We hope that the problems described here today can be similarly resolved in a spirit of rational discussion and cooperation.

Thank you.

CHAIRMAN STEIN: Thank you. Are there any comments or questions?

MR. HARRIS. Thank you, Jim.

Is there a representative present for the State Department of Game? I believe that John Douglas was to present a statement on behalf of the Game Department.

Mr. Douglas.

STATEMENT OF JOHN DOUGLAS
FISHERIES BIOLOGIST, APPLIED RESEARCH DIVISION
WASHINGTON DEPARTMENT OF GAME

MR. DOUGLAS: Mr. Chairman, Conferees. My name is John Douglas, Fisheries Biologist, Applied Research

Division, Washington Department of Game.

The Washington Game Department is vitally interested in any program that will improve the aquatic habitat for fish within the Puget Sound region. The bays, estuaries and salt water environment are essential in the life cycle of our anadromous game fish species, and the quality of this environment is the key to survival of these fish. Pollution of rearing and travel areas is one of the main limiting factors to increased survival of these game fish species.

It is expected that some 2.8 million people will be in the Puget Sound area by 1980. This increased population will create problems in supply and demand of our game fish resources. These people need outdoor recreation outlets for their leisure time as well as jobs to finance these leisure time activities. This cannot be accomplished if one need is developed at the expense of the other. The present pollution of our salt water areas from industrial and municipal wastes to the extent indicated by the report of the Federal Water Pollution Control Administration well indicates the extent of the development of one resource at the expense of another.

The improvement of key salt water habitat would allow an increase in our anadromous game fish populations by permitting greater survival and area utilization of these fish during their salt water life. Increased salt water survival of our natural and hatchery-reared fish would permit this Department to meet a part of the increased demand for outdoor recreation with little expansion of existing facilities.

We, therefore, are very much interested in the proposed cleanup of pollution in the Puget Sound region. We agree with the findings of the Federal Water Pollution Control Administration and urge that the full implementation of their recommendations be made. Only when this implementation occurs can we hope to meet the future demands for better fishing in our fresh and salt water areas.

I thank you.

CHAIRMAN STEIN: Thank you. Are there any comments or questions?

If not, thank you very much.

MR. POSTON: Just a moment.

CHAIRMAN STEIN: Yes, Mr. Poston.

MR. POSTON: I believe there was an appendix to your paper that was prepared--

MR. DOUGLAS: This is Washington Department of Fisheries.

MR. POSTON: I beg your pardon.

CHAIRMAN STEIN: Maybe the states can match us in the intricacies of their bureaucracy.

Mr. Harris.

MR. HARRIS: To show that our fisheries are a little bit split up as far as interests are concerned between game and commercial fisheries, we should like now to call upon Mr. Lassiter of the State Department of Fisheries.

STATEMENT OF J. E. LASATER
ASSISTANT DIRECTOR
WASHINGTON DEPARTMENT OF FISHERIES

MR. LASATER: Gentlemen, I am J. E. Lasater, Assistant Director, Washington Department of Fisheries.

I am always following Game Department people around explaining that while we are different, we are partners. I just might tell you that, similarly to the Federal organization, we are split into two groups, one dealing with those fish which may be taken commercially, which I represent, and those fish which may be taken only for personal use, which Mr. Douglas represents.

So that I won't overlook it, I have been asked by Mr. Russell Bristow, of the Columbia River Fishermen's Protective Association, to tell you in his behalf that he wishes you to know that his organization concurs with the findings and the report on Pollutional

Effects of Pulp and Paper Mill Wastes in Puget Sound. He is not able to be here.

I am presenting this statement in behalf of Director Thor Tollefson of our department.

We appreciate the opportunity to present this statement of our interest in the report of the joint Federal-State studies of water pollution conducted in the greater Puget Sound area. Many of the findings presented in the report reconfirm facts we had previously established, and some of the findings present information and concepts new to us.

Research conducted by the Washington Department of Fisheries has demonstrated the deleterious effects of pulp and paper mill discharge on fish and shellfish. We expressed our concern and documented this at the first session of this conference at Olympia, Washington, in January 1962. Department biologists were key participants in the cooperative Federal-State studies initiated by the 1962 Conference. Our personnel were responsible for the oyster larvae bioassay studies and our comments regarding these are attached to this statement, and I will read them following this initial statement.

We agree with the approach taken in the report presenting the recommendations for each study area.

Since water pollution problems must always be evaluated with respect to the future, there appears to be no alternative but to require reduction or abatement of each existing waste source in conformance with the water quality standards recently promulgated by the Washington Water Pollution Control Commission and to implement the recommendations contained in the FWPCA report, "Pollutional Effects of Pulp and Paper Mill Wastes in Puget Sound", dated March 1967.

Puget Sound is probably the single most important food production reserve we have in the State of Washington and we feel it must be protected. The tremendous food producing potential cannot be fully realized unless the water pollution problem can be controlled and abated. The fact that a fishery or fish population in a specific area does not exist or has already been destroyed by pollution does not justify pollution of the area or failure to correct the pollution problem. Recent reports on estimated State and national population increases and food requirements clearly indicate that we must not only maintain, but also increase the harvest from marine waters. When dealing with a self-renewing resource such as fisheries, the future is in our hands here and now and this is the time when action to abate water pollution is necessary. We have waited too long for voluntary action by the pulp and paper mills to abate the manace of harmful wastes being released into public waters as a result of their operations.

There is an immediate urgency for the abatement of this source of pollution, and we feel that joint State-Federal enforcement action to abate the pollution of Puget Sound waters should be immediately implemented.

I wish now to address myself briefly to the--

CHAIRMAN STEIN: Before you go on, sir.

MR. LASATER: All right.

CHAIRMAN STEIN: You have your appendix. Without objection, this appendix is very short, and it will be included in the record as if read.

MR. LASATER: All right, sir. At your pleasure.

CHAIRMAN STEIN: Go ahead.

MR. LASATER: That is the completion of the statement if you wish just the appendix submitted and not read.

CHAIRMAN STEIN: Do you want to read it? Would you rather read the appendix?

MR. LASATER: I believe I would, sir.

CHAIRMAN STEIN: Go right ahead.

MR. LASATER: For the Conferees.

CHAIRMAN STEIN: Go ahead.

MR. HARRIS: I think Mr. Lasater would prefer to read it.

CHAIRMAN STEIN: That is all right. I thought you were just going to introduce it.

MR. LASATER: No. I will state my reason for that.

CHAIRMAN STEIN: No, this is fine. The option is yours.

MR. LASATER: All right.

This is a statement of the Washington Department of Fisheries giving our position regarding the use and results derived from Pacific oyster larvae bioassays of the waters under consideration.

In view of the fact that over 80 percent of Washington's commercial molluscan production as well as a substantial sport fishery are based on the Pacific oyster, the Department of Fisheries unequivocally endorses the use of the oyster larva bioassay as used in the studies conducted under and reported by this Conference.

The allegation that this species does not qualify as a bioassay organism in these waters because it is an exotic is no more defensible than the argument that a pollutant which kills Chinese pheasants, eastern brook trout, cows, or horses is not injurious to the local fauna.

The argument that oyster larvae are unacceptable as bioassay animals because of the absence of oysters in some of the areas considered is equally preposterous since it assumes that even in the absence of waste discharges oysters could or would not grow and/or reproduce in these areas. In fact, in two of the areas considered, the only recorded oyster setting during the past 20 years and more occurred during 1958 when the major source of pollution was not in operation.

It has also been suggested that since oysters produce millions of eggs,the loss of 50 percent, 75 percent or even 95 percent to some careless activity of man is of no great concern. This argument assumes some sort of a surplus which we can throw away. If, in fact, such a surplus existed, the age-old story of oysters and clams filling our bays and estuaries would have long since come true. In reality, the delicate balance of nature is such that virtually all nondomestic, unprotected species over the long haul survive at a one to one ratio over the life span of an individual and any change in survival at any stage of the life cycle, regardless of how small, may have profound effects on survival or destruction of the population of concern.

The use of oyster larvae bioassays have been challenged on the grounds that this assay considers only a single delicate stage of the animal's life cycle and as such cannot be used in making inferences about effect on adults or the population. It should be obvious to even the most poorly informed that if reproduction of the animal is stopped, there will very shortly be no survivors to concern ourselves with. In addition to this, we must note that research by the Department of Fisheries indicates toxicities of some wastes as measured by percent abnormal larvae in the 48-hour Pacific oyster embryo bioassay closely parallel toxicity levels determined through increased mortalities, decreased fatness, and reduced reproduction by adult oysters.

However, the most damning finding of the bioassay studies reported by the Conference is the results of bioassays conducted before, during, and subsequent to the complete shutdown of a single industry in the autumn of 1964 in three of the four areas being considered by this conference. During this period frequent oyster larvae bioassays clearly showed the decline to virtually no toxicity of the waters in the absence of waste discharges and a rapid return to toxic conditions within a matter of days of resumption of waste discharging. This large-scale experiment conducted in the areas of actual concern clearly demonstrates the ability of the oyster larva bioassay to measure water quality.

In addition to fully endorsing the oyster larva bioassay's use to measure water quality with regard to molluscan shellfish, we further note that areas which support oyster populations generally also support substantial populations of other fish and shellfish. Therefore, we are reasonably confident that waters in which oysters and their larvae survive are waters that will support other commercial fisheries.

Thank you very much.

CHAIRMAN STEIN: Thank you, Mr. Lasater.

Are there any comments or questions?

If not I have a question. Maybe you are at the wrong place in the record, but you base a good portion of your statement on the argument that oyster larvae are unacceptable as bioassay animals. I have heard no allegation to that effect. Who makes it?

MR. LASATER: I am very pleased that you haven't. We have heard--

CHAIRMAN STEIN: Well, we haven't had it

in the record here, have we? No one stated that.

MR. LASATER: I don't believe so, but I don't believe it is out of place to meet an argument even prior to its coming up.

CHAIRMAN STEIN: Well, we have heard from the State and the Federal Government and I didn't hear any allegation that this was an unacceptable tool.

MR. LASATER: I don't expect the problem to come from the State or the Federal Government fellows at all. I am quite sure that any of them will accept it. I will be followed by other speakers and I do know some of the arguments that have been raised to us or that we know about.

If they are not brought up at all to this body, then please disregard any comment. (Laughter)

CHAIRMAN STEIN: Well, thank you.

MR. HARRIS: I think you explained that very well. (Laughter)

CHAIRMAN STEIN: Mr. Harris.

MR. HARRIS: The next member we have from the State of Washington is a distinguished member of the University of Washington faculty, Professor Robert Sylvester.

PERSONAL STATEMENT OF ROBERT O. SYLVESTER
PROFESSOR OF SANITARY ENGINEERING
UNIVERSITY OF WASHINGTON

MR. SYLVESTER: Mr. Chairman, Conferees, ladies and gentlemen.

I am giving my statement as a citizen, not as a representative of any State agency.

My name is Robert Sylvester. I am Professor of Sanitary Engineering at the University of Washington.

CHAIRMAN STEIN: Let me say this before I know what is in the statement.

Mr. Sylvester in water pollution control is indeed one of the State's most distinguished citizens and probably one of the most distinguished in the country in this field.

MR. SYLVESTER: You should make those remarks after I have delivered my statement. You might want to retract them. (Laughter)

CHAIRMAN STEIN: That is why I said it before you delivered the statement.

MR. SYLVESTER: Thank you.

First I would like to compliment the Federal Water Pollution Control Administration and the Washington Water Pollution Control Commission for the report delivered this morning. This, I think, is a very comprehensive and most detailed report, perhaps more so than any we have seen of this type in the past. As in any study and report of this complexity, it can be subjected to questions on methodology, results, conclusions and recommendations. However, these questions are not as important as to question the objective of this study.

The principal objective of the investigations as initiated by the 1962 Enforcement Conference in Olympia was to determine whether the marine environment has been damaged as the result of pulp and paper mill waste discharges. This objective, necessitated by the Enforcement Conference, is a negative approach in a modern program of water quality control for the maintenance or enhancement of a water environment. If damage must be proven in an enforcement program before corrective measures can be obtained, then some of the beneficial uses of the waters have already suffered. In a developing area, these damages can increase more rapidly than corrective measures. When carried to the extreme, as has been the case in some areas, water uses other than waste disposal have declined and there remains little left to protect. The cost to reverse these mistakes in water management are so great that pressures develop to commit the waters to this condition. Since a water resource must serve many conflicting demands, those users that can degrade the water quality and reduce the usefulness of a water resource should demonstrate that their actions are not harmful or face the cost of this damage.

It is a most difficult task to prove damage to a water environment unless the damage be so severe that it is obvious to all. Pollutants are many and their effect on water uses is not well understood. Some types of damage can be subtle, difficult to observe, and may only be evident after a long period of time has elapsed. Other than outright death of water biota or the contraction of disease by humans, we have no widely accepted parameters of total pollution damage. Water quality management must optimize the long-term stream of beneficial uses and not seek non-optimum short-term solutions.

Consideration of the results, conclusions and recommendations of this report should not be restricted to whether or not significant physical damage has been caused by waste discharge or on the identifiable dollar value of one use versus another. Rather they should be viewed with the following considerations in mind:

1. The marine waters in question are public waters that must be suitable for all to enjoy and use wherein one does not gain at the expense of others

and wherein future industrial expansion and other uses are maximized.

2. We are slowly awakening to the necessity of maintaining or enhancing the quality of our water, air and land environments. Much legislation has been devoted to this subject and policies have been established. It is, therefore, necessary that the recommendations and conclusions in the report be viewed not only as to their conformance with details of State and Federal legislation but also as to their conformance with legislative policy.

3. Within the constraints of our present technology and economic capabilities it is necessary that wastewaters from municipalities, industry and agriculture be returned to nearby receiving waters not entirely free of pollutants. However, are all substances that can be readily removed from these waste streams being removed? Are the municipalities and industries mentioned in the report being asked to remove substances that are technically and economically infeasible of removal or that are not being removed by others within similar economic communities or competitive markets?

4. Water quality control measures are costly and represent costs to all segments of society.

Are the costs entailed in the recommendations of the report unreasonable when compared with other expenditures in this complex society and can society avoid these costs as we look to the future?

Let us hope that this Conference will concern itself with these broader aspects of water quality management and not become involved in debates over just how much of this or that pollutant can be presently absorbed by the environment without most serious consequences.

CHAIRMAN STEIN: Thank you, Professor Sylvester.

Are there any comments or questions?

You know, your statements are a little ahead of the Congress. The Congress heeded your statement here: "If damage must be proven in an enforcement program before corrective measures can be obtained, then some of the beneficial uses of the waters have already suffered." The FWPCA and the State have to work under existing law. We started this in 1962. It wasn't until 1965 and 1966 that the Congress attempted to get at the preventive aspects of water pollution control through the standards mechanism.

In regard to your questions, I don't know if they have been satisfactorily answered, but it seems to me that the report of the Federal people, and particularly the summary made by Mr. Kari, attempted to get at some of the questions you have raised in 1, 2, 3, 4. I don't know that you are satisfied or anyone here would be satisfied with the recommendations he made, but certainly your questions are very pertinent and should be considered, I think, and will be by the Conferees. As always, your statement has been very helpful.

MR. SYLVESTER: Thank you. I was aware and I tried to bring it out there that your 1962 Conference was made before recent legislation.

CHAIRMAN STEIN: That is right.

MR. SYLVESTER: And you operated under that restraint.

CHAIRMAN STEIN: Right.

Thank you.

MR. HARRIS: Thank you, Professor Sylvester. Professor Sylvester, you have a very meaty discussion here and I believe that it has given a lot of us food for thought.

At this time I would like to call upon Mr. James E. Phillips, who is the President of the First National Bank of Port Angeles and also President of the Chamber of Commerce of Port Angeles.

Mr. Phillips.

STATEMENT OF JAMES E. PHILLIPS
PRESIDENT, FIRST NATIONAL BANK
PRESIDENT, CHAMBER OF COMMERCE
PORT ANGELES

MR. PHILLIPS: Mr. Chairman, members of the Conferees.

I wish to thank the Chairman for making it possible for me to make a statement at this hearing.

Gentlemen, I assure you that we in Port Angeles have followed the proceedings of this Conference closely since its inception in 1962. I, of course, represent that very large and typical section of the public who are neither scientists nor specialists in the field of water quality or its needs.

This, however, does not mean that we are not of consequence even in a technical controversy such as this one. Quite to the contrary, we like to feel that we are the most important people in the act: We are the general public for whom any required actions here are to be taken, and we do most sincerely appreciate the efforts of all concerned on our behalf.

It is on this basis that I have asked to speak today, because there are many of us in Port Angeles who have been becoming increasingly concerned over one aspect here, the possibility of trading a very minor, questionable problem for a possibly very real and serious problem, that of air pollution.

We have lived with the pulp and paper industry long enough to know that a recovery process involves the burning of some of the wastes, and that this in turn can in many cases lead to at least intermittent air problems no matter how careful the industry may be.

Frankly, gentlemen, from a simple public standpoint, we do not feel that our water in Port Angeles Harbor is in such bad shape. In fact, one has to go out and search to find the questionable conditions. We have seen times and places in other towns where this is not true in respect to the air. Sometimes it just plain smells.

I repeat, we are not sure if a problem actually exists. In the last issue of Sports Illustrated dated September 4, 1967, on Page 10 they carry a story called "Population Explosion". I would like to read from this article if I may. I quote:

"Sometimes it happens--a river becomes too crowded with fish for fish to survive, for sportsmen to catch them and even for biologists to count them. It has been happening this summer on the Dungeness, a pretty little Alder-lined stream that forms in Washington's Olympic

Mountains and flows 35 miles north to the Strait of Juan de Fuca."

This is roughly ten miles east of Port Angeles where the mouth of the river is.

"In 1959, when the Washington state fisheries department began counting the humpback salmon that spawn in the Dungeness, there were 40,000 of them. This summer it was obvious by the end of the second day of the month-long run that there would be many more than that: counters near the mouth of the river had already ticked off 16,000 fish. If the rush continued, late arrivals would destroy the beds where the early comers had spawned. 'A crisis was developing,' said Earle Jewell, a state biologist, 'so we decided to charter purse seiners on an emergency basis. We got fishermen out of bed on Friday night and managed to have seven of them fishing the outer bay on Saturday and Sunday.

"But the commercial fishermen hauled in only 4,000 fish over the weekend. And by Sunday the counters had registered more than 70,000 swimming up the Dungeness. Humpback salmon are small as salmon go, and they went around, under and through nets intended for bigger sockeye salmon. Next the fisheries department used beach seines manned by department personnel, but that did not work either. At last, five miles of the lower river were opened to sport fishing with hook and line.

"That worked. For two weeks some 15,000 men, women and children were up to their icy kneecaps in the swift water of the Dungeness, feverishly taking salmon.

"Some families canned their fish on the banks of the river. In all, the fishermen took at least 15,000 salmon, and probably assured the success of the next run, which will come in 1969."

End of article.

It has been my observation that the fishing in the Port Angeles area is influenced by factors other than the application of the forest products industries. These concerns have operated almost continuously for many years with their methods of waste discharge being essentially unchanged and with production increases being of an incremental nature. Fishing, on the other hand, has over the years varied from being extremely good to extremely bad, and this has been a particularly good year.

We have just recently seen the water quality standards which the State Water Pollution Control Commission has proposed to the Department of the Interior. I do not know how the Commission arrived at the present and proposed water uses for the Port Angeles area because it is so obvious that they do not reflect the facts of life. Bathing and swimming are out of the question due to the very low temperature of the water and the brisk wind which usually prevails. Shellfish growth and propagation is totally impractical, as I understand it, because of the low temperature of the water and the lack of extensive tidelands required for this sort of seafood production. The industrial water supply for our industries comes from the Elwha River, and because of this, listing industrial water supply as one of the uses of the harbor water is in error.

The waters immediately adjacent to Port Angeles are used for the movement and storage of large quantities of logs, marine transportation, fishing, boating and boat havens, and for waste assimilation. These uses appear to be very compatible because of the extremely large volume of water available and because of the strong tidal action which changes the water in the harbor in less than a day.

The State of Washington is presently enjoying an economic boom. This is not true, however, in the Port Angeles area. Since 1941 only one new manufacturing industry has been located in Clallam County.

They currently hire 100 men. In those 26 years we lost one similar industry employing 50 men. Recent figures furnished by the Washington State Employment office indicate that the total employment in manufacturing, other than logging, in Clallam County has declined by 7 percent in the nine-year period from 1958 to year end 1966.

Several of the larger Port Angeles industries already work at an economic disadvantage, in comparison with other upsound mills, because of freight costs, and I would hate to see them saddled with additional costs for water quality improvement unless there is an unquestionable need for improvement in this area. It was only a few short years ago that the City of Shelton lost one of its major industries when operational costs in the Shelton plant became too high in comparison with other possible plant locations.

I don't know if this is considered proper at one of these Conferences, but I earnestly plead with both the State and Federal regulatory people here today to be extremely careful in what you do, and that you do consider all of the relationships here before you take your final action. We in Port Angeles don't mind our water, and we like our air. Please do not lower the quality of either one. Thank you.

CHAIRMAN STEIN: Do you want that table included?

MR. PHILLIPS: I beg pardon?

CHAIRMAN STEIN: Do you want the table attached?

MR. PHILLIPS: The table attached proves the point that I have made that there has been a 9 percent decrease in manufacturing, in employment in Clallam County in the years 1958--

CHAIRMAN STEIN: Do you want this included in the record?

MR. PHILLIPS Yes. sir.

CHAIRMAN STEIN: Without objection, this will be included as if read.

MR. PHILLIPS: Thank you.

(The table referred to appears on page 170a.)

CHAIRMAN STEIN: Are there any comments or questions?

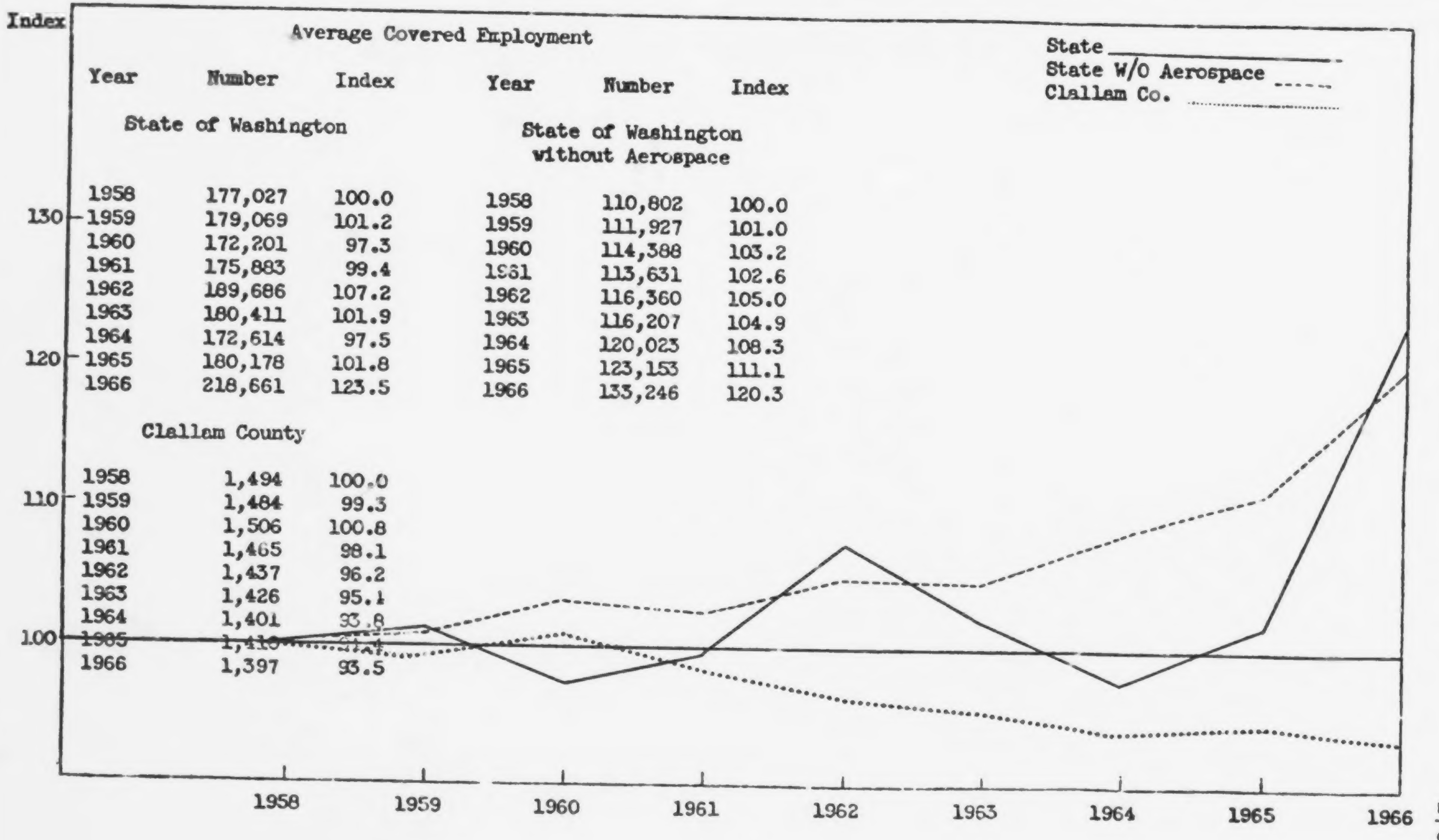
MR. HARRIS: We have one other statement. Mr. Philip Parker.

STATEMENT OF PHILIP H. PARKER
EXECUTIVE SECRETARY
PACIFIC COAST OYSTER GROWERS ASSOCIATION

MR. PARKER: Chairman Stein, Director Harris, ladies and gentlemen.

Table 4

Index of Annual Average Covered Employment, State of Washington, State of Washington without Aerospace, and Clallam County, MANUFACTURING OTHER THAN LOGGING, LUMBER, AND WOOD PRODUCTS, 1958-1966 (1958 = 100)



Average Covered Employment

Year	Number	Index	Year	Number	Index
State of Washington			State of Washington without Aerospace		
1958	177,027	100.0	1958	110,802	100.0
1959	179,069	101.2	1959	111,927	101.0
1960	172,201	97.3	1960	114,388	103.2
1961	175,883	99.4	1961	113,631	102.6
1962	189,686	107.2	1962	116,360	105.0
1963	180,411	101.9	1963	116,207	104.9
1964	172,614	97.5	1964	120,023	108.3
1965	180,178	101.8	1965	123,153	111.1
1966	218,661	123.5	1966	133,246	120.3

Clallam County

Year	Number	Index
1958	1,494	100.0
1959	1,484	99.3
1960	1,506	100.8
1961	1,465	98.1
1962	1,437	96.2
1963	1,426	95.1
1964	1,401	93.8
1965	1,410	[illegible]
1966	1,397	93.5

PHILIP H. PARKER

My name is Philip H. Parker. I am Executive Secretary for the Pacific Coast Oyster Growers Association, a trade association which represents the interests of oyster growers and processers in Washington, Oregon, California, and British Columbia.

I do not believe it is presumptuous to say that I also speak here today, in a general way, for the thousands upon thousands of citizens of the west who share with us a deep and abiding concern for the need to conserve and husband our priceless water resource. Because of the oyster industry's long standing interest and widely recognized leadership in the struggle to protect and preserve clean water, these citizens, lacking a strong organized voice of their own, have turned to us to speak on their behalf at such public forums as this. This is a responsibility which we welcome and which we accept with both pride and humility.

This Conference is being held here today largely because our industry, long the victim of the polluters, demanded some kind of reasonable, rational, responsible action on the part of our public officials to effectively deal with a problem which was and still is threatening to permanently damage a basic natural resource. We are pleased that such action was begun. We consider this Conference and its work up to this point the first step of any real significance to be taken so far in the matter of conserving the waters of the Puget Sound.

We concur heartily in the findings of the four-year study made by the Federal Water Pollution Control Administration and we endorse emphatically the recommendations of that report. Both the findings and the recommendations confirm what oystermen have long known and advocated. We cannot help but feel that it is unfortunate that it was necessary to spend four years and a million and a half dollars to prove that which was already a known fact, but happily that has now been done to everyone's satisfaction except, of course, the polluters.

I might add parenthetically here, Mr. Chairman, that we especially appreciate the concise clarity with which the report has been submitted to the public. This is an important aspect of the understanding which those people who are not technically capable of understanding many of the intricacies of the problem need in order that they may take their rightful place in any discussion and dialogue of a problem so basic to them.

Up to now, oystermen have waged the battle for clean water from the point of view of a relatively small industry fighting for its very existence and out of a deep-seated conviction that man, so completely dependent upon water as he is, must learn to place his purely economic interests in this vital resource in a position of secondary importance behind the primary concern for the protection and preservation of the resource itself. This latter conviction remains paramount in our thinking today, but our view of our economic interest in water has vastly been altered in the past two weeks.

At the twenty-first annual convention of our Association last month we were presented a thoughtful, well-researched and documented paper by a widely known and highly respected fisheries biologist which disclosed that the Puget Sound was potentially capable of producing annually an amount of oysters equal to the total production of all fisheries products now produced in the entire United States. This revelation staggers the imagination. At the same time, it drastically alters our industry's self image. The implied responsibility to fully utilize this vast food-producing potential in a world that is crying for increased production of scarce protein looms immediately. The possibility of transforming an industry which now contributes about 10 million dollars annually to the economy of Washington to one adding something around 10 billion dollars a year is exciting, is challenging, and, needless to say, intriguing.

The paper to which I refer was authored by Mr. Ronald E. Westley, Senior Biologist in charge of the Washington State Department of Fisheries Point Whitney Shellfish Laboratory. I wish to request your permission, Mr. Chairman, to offer a copy of this significant work for inclusion in the official records of this Conference.

CHAIRMAN STEIN: How long is that statement, that paper?

MR. PARKER: About four or five pages.

CHAIRMAN STEIN: Without objection, that will be included as if read.

(The paper referred to follows:)

"THE OYSTER PRODUCING POTENTIAL OF PUGET SOUND

"State of Washington
DEPARTMENT OF FISHERIES
Research Division

"Ronald E. Westley
Fisheries Biologist
August 1967

"Evaluation of the oyster producing potential of Puget Sound is a complex task, involving examination of the many widely differing circumstances and conditions which control oyster production. I believe that such an evaluation is both desirable and necessary for three important reasons. (1) Good stewardship of our resources requires a basic understanding of their potential. (2) The current predicted need for additional sources of food makes it necessary to know what our resource is capable of. (3) It is only thru full realization of the magnitude of the oyster producing potential of Puget Sound that adequate consideration can be given to this resource in the continually increasing competition for use of the water.

"Many biological, hydrographic, and geographic factors, along with cultural techniques, interrelate to determine what the oyster producing potential of Puget Sound is. Demand for oysters, economics, and competition for use of the water area will determine what portion of this potential will actually be realized.

"In making this evaluation I would first like to briefly consider some aspects of demand, and secondly go on to review in some detail the actual producing potential of Puget Sound.

"Demand for oysters is governed by many factors. Some clues that seem particularly important in evaluating demand are past and present rates of oyster production and the reasons for changes; the trend of human population; and the general availability of food, present and future.

"Figure 1 presents an evaluation of oyster production in the United States taken from Engle (1966). This shows that U. S. oyster production has declined at a fairly constant rate for the past 50 years. These data also indicate that a majority of this decline has occurred on the East Coast of the United States where many areas have gone out of oyster production (for various reasons including pollution, over-harvest, set failures, and oyster diseases). Figure 1 also shows that oyster production on the Pacific Coast while fairly low, has remained stable over the past several years.

"Changes in population, both locally and nationally, will also have an important effect on future demand for oysters as well as the general world food supply. There are many different sources or experts available on the subject of population increase (Panel on oceanography 1966 (Larkin 1965) Senti 1967); but there does seem to be some agreement that world population will double by the year 2,000, and may go up as much as 10 times the present figure before it levels off. The State of Washington is expected to grow faster than the national rate, and it is anticipated that the population of this state will nearly double by 1985 (Washington Department of Commerce and Economic Development).

"The present available food supply and the potential for increase is another important aspect of this problem. In the report of the Panel on Oceanography (1966), it is stated that there is now a world-wide shortage of protein food and that about half of the mortality of children between ages 1 and 5 is due to a protein-deficient diet. Agricultural experts (Senti 1967) indicate real concern about making adequate increases in food production from the land.

"It seems clear that because of the nationally decreasing oyster production, the increasing population, and the present food shortage, there should be a continuing increase in demand for good oysters. Any area capable of economically competitive production should be able to sell increased quantities of suitable quality oysters.

"Next, I would like to make some evaluation of the oyster producing capabilities of Washington State and particularly of Puget Sound. Some of the basic factors that are important in such an evaluation are basic fertility of the water, extent of the suitable area available, and cultural techniques that fit the environment.

"The water must have high fertility (an abundance of oyster food) in order to sustain any major increase in oyster production. Puget Sound has long been recognized by professional oceanographers as a unique body of water. For a number of complicated reasons it is quite high in its supply of chemical nutrients; however, it is only recently that studies have progressed to a point where the tremendous fertility and food producing ability of Puget Sound has been truly recognized. Anderson (1967), studying primary productivity (the basic conversion of chemical nutrients into living plant material) in Puget Sound, comments that primary productivity rates in Puget Sound are among the highest observed in marine waters around the world. Recent work by our laboratory (Westley 1967) (Westley et al 1967) also confirms the amazing fertility or productivity of Puget Sound.

"Primary productivity (or basic plant production) in the sea is no final solution to the problem of producing food for humans. To be of real value this plant production must be converted to animal protein.

"It is a well known fact that each time conversion to the next highest step in the food chain occurs, there is a major loss. Therefore, the more times the basic plant production has to be converted before the food can be used for humans, the lower the ultimate production will be.

"Because the oyster feeds directly upon the basic plant material, it is one of the most effective organisms in the marine environment for conversion of plant material to animal protein.

"From the foregoing it seems evident that if the tremendous fertility of Puget Sound could be combined with the efficiency of the oyster converting this fertility to animal protein we would have a highly effective system for large scale production of animal protein.

"The next question to consider might logically be the available area for expanding oyster production in Puget Sound. At the present time, many of the more favorable intertidal areas for conventional bottom-culture of oysters are in use. While it seems evident that significant increases in oyster production thru conventional bottom-culture could be made, these increases are definitely limited.

"There is however, a different method of oyster culture, such as is practiced in Japan, and to a limited extent here on the Pacific Coast, involving raft or floating culture of oysters (Cahn 1950, Quayle 1956). This method would appear to offer tremendous potential for increased oyster production, both because of the greatly increased surface area it would make available, and because it would utilize up to 15 feet of the water depth. Also, by using appropriate modifications of the basic floating method, it would appear that wave action or exposure would not be a significant problem in any portion of Puget Sound. In addition floating oyster culture offers advantages of nearly double growth rates and improved fatness. It does have the disadvantage of heavy initial financial outlay (Quayle 1956).

"To determine the total amount of area potentially available in Puget Sound for floating oyster culture, I have utilized data published by the University of Washington Department of Oceanography (McLellan 1954) on area and volume of greater Puget Sound (Figure 2). Based upon the need for boat access along the shore line, and the difficulties that would be encountered in anchoring floats in water depths greater than 20 fathoms, the surface areas between the 3 and 20 fathom contour was selected as being suitable. There are about 442 square nautical miles of surface area within this depth range in the greater Puget Sound area. If an attempt were made to utilize all of this area, major problems would be encountered because of public health, pollution, water traffic, and recreation. However, it seems reasonable to believe that perhaps half of this area could be made available for floating oyster culture if demand and need for food became great enough.

"Thus of the 767.6 square nautical miles of Puget Sound, 442 lie in the zone between 3 and 20 fathoms depth. If we would consider that half of this could be available for floating oyster culture, we are considering an area of about 221 square nautical miles or approximately 187,408 square surface acres. This would be about 28% of the total surface area of Puget Sound.

"Various estimates of the yield per acre from floating oyster culture are available. Quayle (1956) reports a figure of up to 8,000 bushels per acre per year for Japan. Converting Quayle's figure of 8,000 bushels to pounds of meat on the basis of 1 gallon per bushel, and 8 pounds of meat per gallon, we arrive at a figure of 64,000 pounds per acre per year. The Panel on Oceanography (1966) reports 16,000-32,000 pounds per acre per year from Japan. Thus the available estimates on annual production of oysters by the floating method range from 16,000 to 64,000 pounds per acre. Table 1 presents the per acre production figures for floating oyster culture and, for comparison, production figures for several other marine and land crops. From this we see a production of around 300 pounds per acre per year for upland crops, 600 pounds per acre per year for oyster production on the east coast of the United States; 800 pounds per acre per year for conventional bottom oyster culture in Washington and estimates of 16,000 to 64,000 pounds per acre per year for floating oyster culture in Japan. This would seem to clearly demonstrate the tremendous food producing potential of floating oyster culture.

"Finally, Table 2 puts some of these figures together to make an estimate of the oyster producing potential of Puget Sound. Using 221 square nautical miles for the available area and 32,000 pounds per acre per year (a median figure) as the yield, the calculated potential yield from floating oyster culture would be about 6 billion pounds of meat per year for Puget Sound. To illustrate the magnitude of this figure, I have utilized data presented in Figure 3, taken from Larkin (1965), illustrating annual total fisheries production by various nations. I think it is particularly significant to note that the total U. S. fisheries production, all species, is now about 6 billion pounds per year or roughly equivalent to the amount I have calculated for the potential oyster production of Puget Sound.

"I don't pretend to be able to forecast whether or not this oyster production will ever be reached in Puget Sound. Many problems would have to be met and overcome to accomplish this.

"First of all, there must be demand; second, this production must be economically competitive; third, we must have an adequate seed oyster supply; fourth, the needed water area would have to be set aside for this use; and fifth, the waters will have to be protected from pollution. However, certain other positive factors would seem to hold promise for a change in the outlook for our oyster industry.

"1. Population is rapidly increasing, and there is a need for new sources of food.

"2. Oyster production in Puget Sound would be clearly under United States control and not subject to harvesting by foreign nations. In contrast any extensive fishery developed on the high seas could be subject to harvesting by foreign nations.

"3. Puget Sound is a tremendously rich estuary, capable of enormous food production.

"4. The oyster would be one of the most effective methods of converting the food producing potential of Puget Sound into animal protein.

"5. Floating oyster culture is a tested method, known to produce enormous quantities of food, and the basic technique could be quite successfully carried out in Puget Sound.

"From this, one fact emerges very clearly, Puget Sound is an extremely valuable resource capable of very substantial food production. I think every effort must be made to protect and preserve this resource so this potential will not be wasted or destroyed.

Table I

Land Crops

Swine (Cultivated Land) 450 lb. per acre per year[1]

Cattle (Grass Land) 5 - 250 lb. per acre per year[1]

Oyster Bottoms

Chesapeake Bay 600 lbs. per acre per year[1]

Washington State

20 cases of seed per acre
x 15 gal. per case yield
300 gal. per acre yield
x 8 lbs. per gal.
2400 lbs. per acre yield
÷ 3 years per crop = 800 lbs. per acre per year

Floating Oyster Culture

Japan 16,000 - 64,000 lbs. per acre per year[1 & 2]

[1] Panel on Oceanography, 1966

[2] Quayle, 1956

Table 2

Total Surface Area of Greater Puget Sound

767.6 square nautical miles

Surface Area Between 3 & 20 Fathom Depth Contours

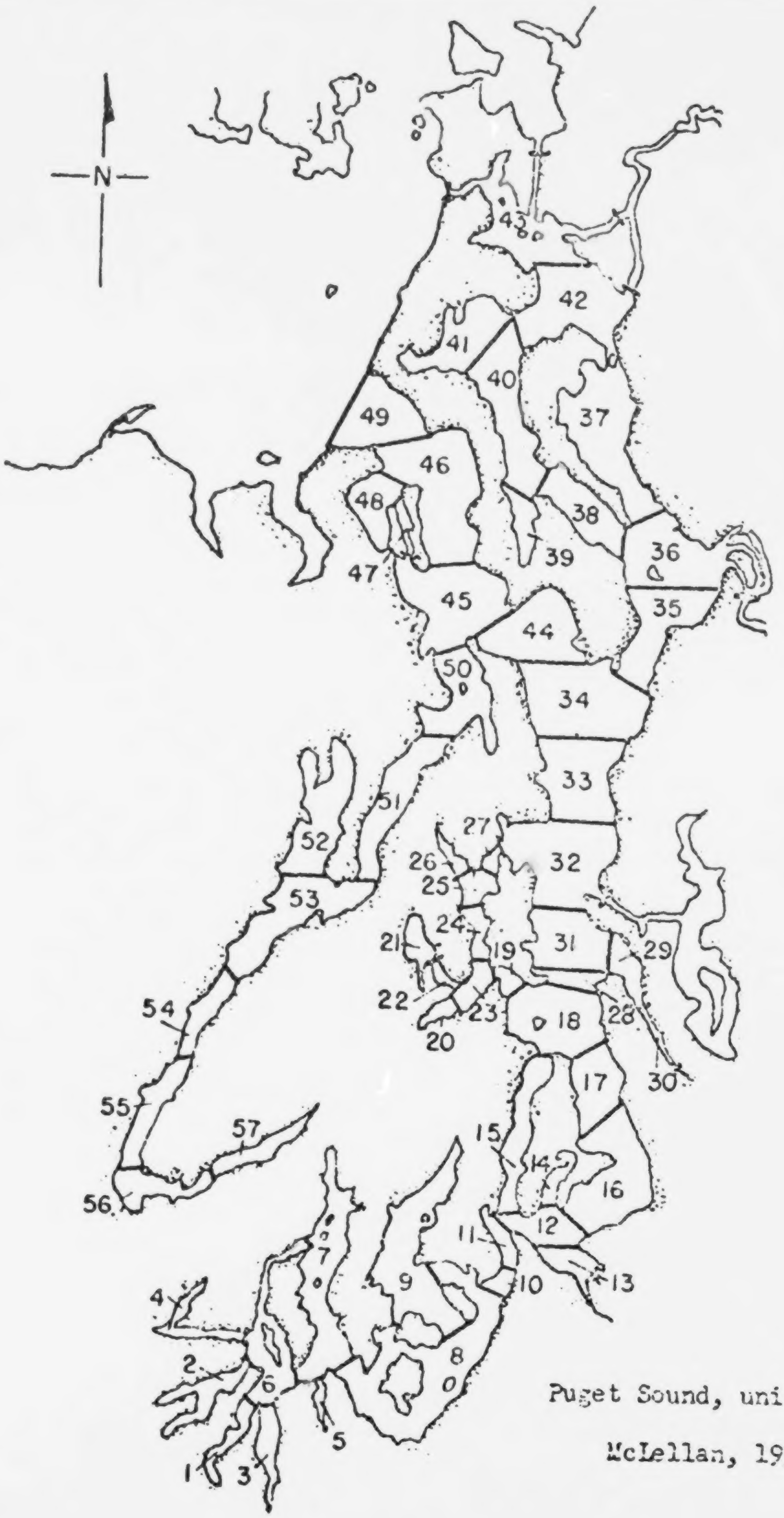
$\frac{442}{2}$ square nautical miles

221 square nautical miles

$\frac{767.6}{221}$ = Approx. 28% of the Surface Area of Puget Sound

221 sq. naut. mi = Approx. 187,408 square acres

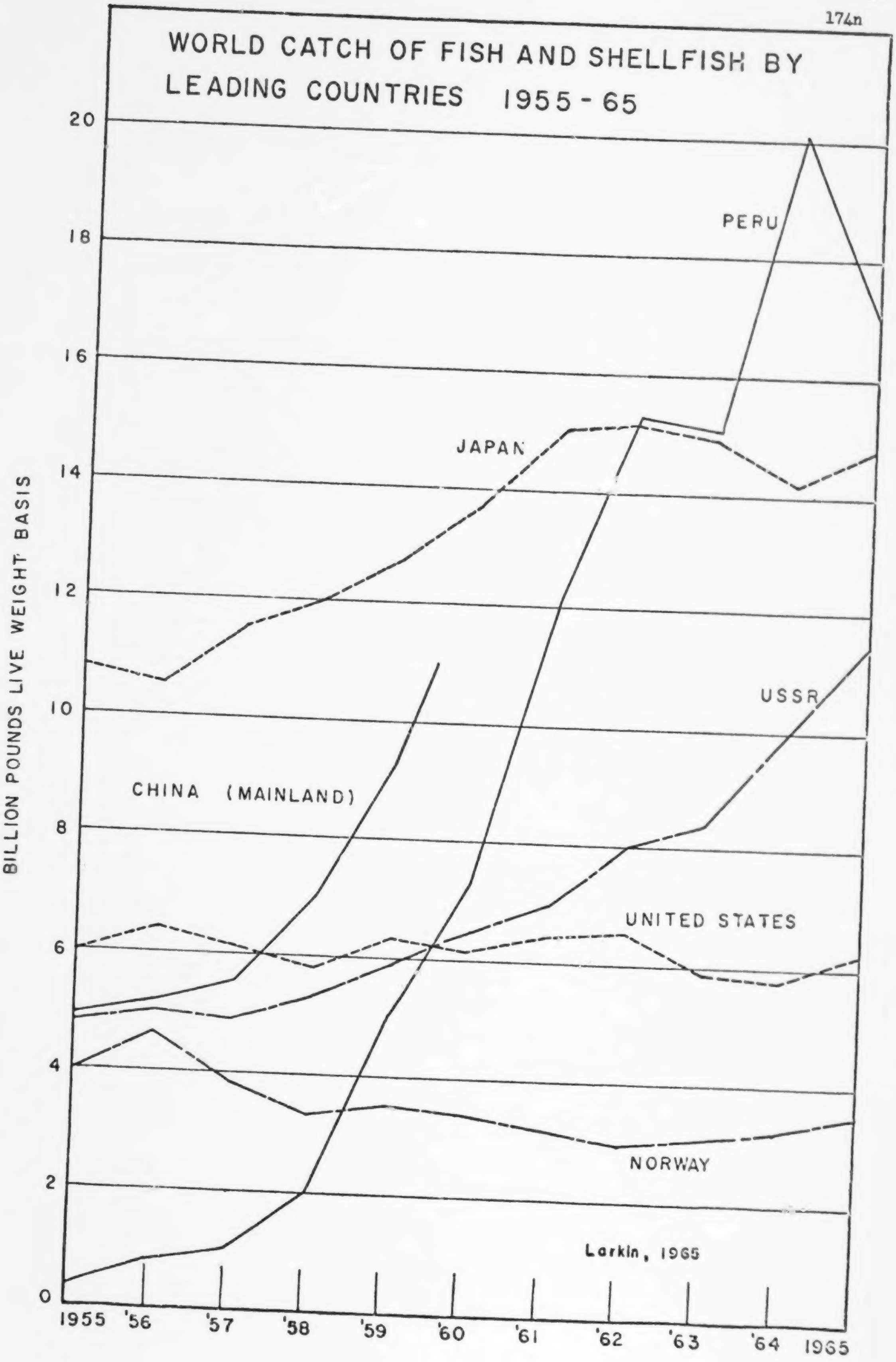
```
   187,408  square acres
   x32,000  lbs. per acre per year
 374816 000
 562224
5,997,056,000 lbs. per year
```


N
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57

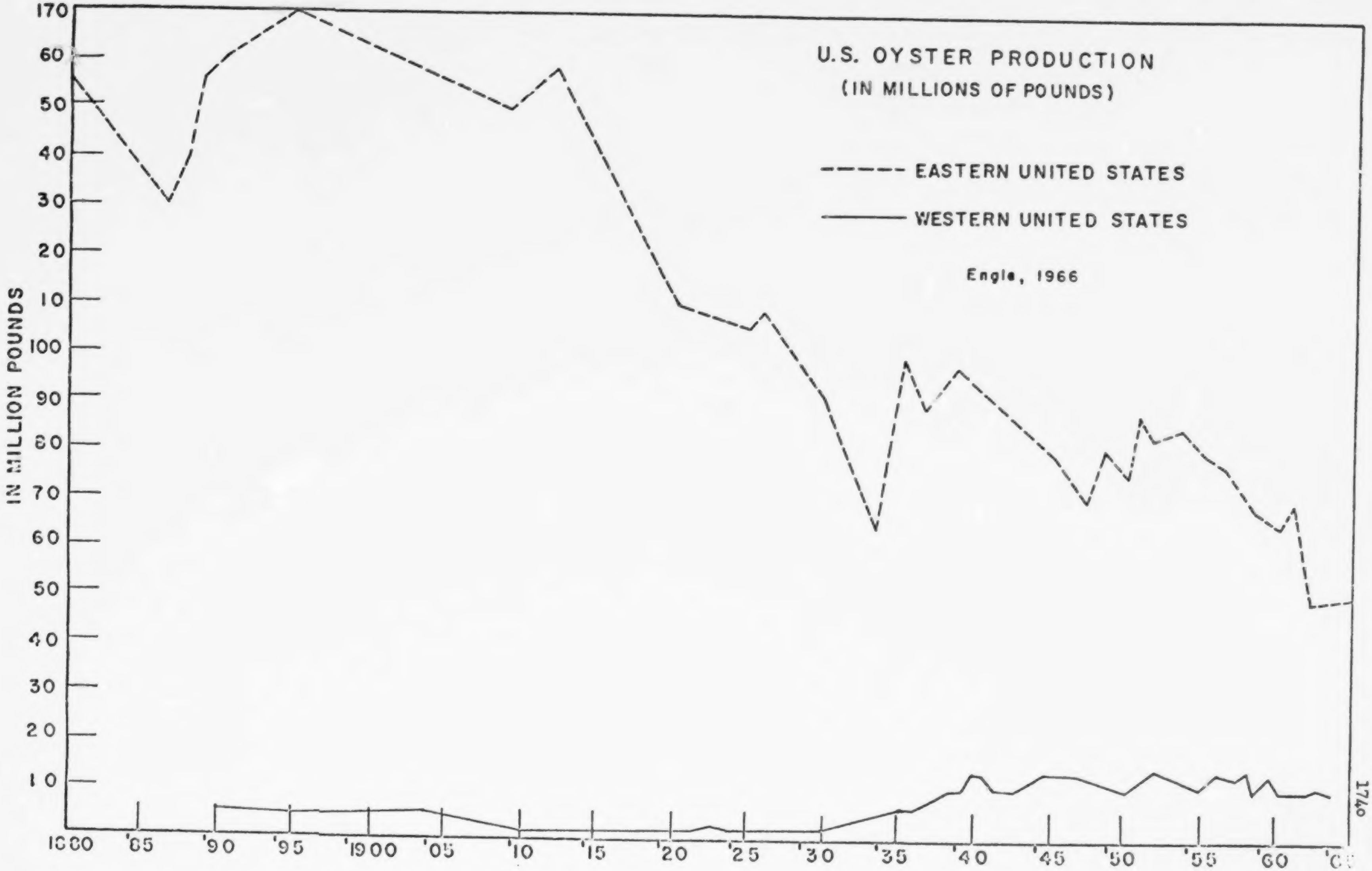
Puget Sound, unit-areas

McLellan, 1954

WORLD CATCH OF FISH AND SHELLFISH BY LEADING COUNTRIES 1955 - 65



Larkin, 1965



U.S. OYSTER PRODUCTION
(IN MILLIONS OF POUNDS)

Engle, 1966

1740

PHILIP H. PARKER

"REFERENCES

"Anderson, G. C.

"1967. Initiation of phytoplankton blooms. *Paper presented at* Pacific Oyster Mortality Workshop, Seattle, Wash., May 1967.

"B. C. Dept. of Fisheries

"1954. Floating oyster culture. Oyster Bull. *5* (2): 1-4.

"Cahn, A. R.

"1950. Oyster culture in Japan. U. S. Fish. Widl. Serv. Fishery leaflet 383, 80p.

"Dept. of Comm. and Econ. Develop., State of Wash.

"1967 Estimated total labor force employment and population Washington State 1965-1985. Olympia, 1p.

"Engle, J. B.

"1966. The molluscan shellfish industry current status and trends. Proc. Nat. Shellfish Assn. *56*: 13-21.

"Larkin, P. A.

"1965. North American fishery potential. *In* the Fisheries of North America, Washington D.C. 72p.

"McLellan, P. M.

"1954. An area and volume study of Puget Sound, Washington. U. of Wash. Dept. of Oceanography, Tech. Rept. 21. 39p.

"Presidents Science Advisory Committee, Panel on Oceanography

"1966. Food from the sea. *In* Effective Use of the Sea, Washington, D. C. 144p.

"Quayle, D. B.

"1956. The raft culture of the Pacific oyster in British Columbia. Fish. Res. Bd. Can., Prog. Rept. 107: 7-10.

"Senti, F. R.

"1967. World food supply. Science *155* (3764): 874-875.

"Westley, R. E.

"1967. Some relationships between Pacific oyster (*Crassostrea gigas*) condition and the environment. Proc. Nat. Shellfish Assn. *55*: 19-33.

"Westley, R. E., A. J. Scholz, C. E. Woelke, and M. A. Tarr

"1967. Pacific oyster mass mortality studies. State of Washington, Dept. of Fisheries, Summary Report, Olympia 45p."

MR. PARKER: Mr. Westley points out, among other things, that one of the basic conditions to the realization of this gigantic food-producing potential is that "the waters will have to be protected from pollution", to which we can only add amen.

Pollution of the Puget Sound as seen from this new and lofty vantage point takes on an equally new and challenging significance. No longer can degradation of these waters be viewed as only a "minor and vexing necessity of our industrial establishment." No longer can it be seen in terms of the primacy of one big industry over the requirements of a small and struggling group of farmers bravely, although be it somewhat pathetically, battling for their own self-interest. The order of magnitude of the problem has changed. It must now be seen and dealt with for what it really is. The question now becomes: Shall the reckless self-interest of the polluters continue to be allowed to thwart the vast protein productive capacity and the considerable economic potential of these rich waters? Oystermen say the answer is not just a simple "no", but an emphatic unequivocal "hell, no".

We are confident the citizens of this State join us enthusiastically in this position and we call upon--yes, we demand--the immediate and full implementation of the recommendations of the report of this Conference, and we ask that our public officials and our industrial leaders recognize and accept their responsibility for the accomplishment of the objectives of this report at the earliest possible date.

Thank you for inviting us.

CHAIRMAN STEIN: Thank you, Mr. Parker.

Are there any comments?

MR. HARRIS: No.

CHAIRMAN STEIN: Both Mr. Parker and Mr. Lasater sort of anticipated objections. At the present time I have heard nothing in the record that indicates substantial disagreement with the Federal and State reports. Maybe I am overly optimistic.

We will have a 15-minute recess. Don't go away, because the cereal is getting thick. (Laughter)

(RECESS)

CHAIRMAN STEIN: May we reconvene?

Before Mr. Harris continues with the State invitees, I would like to repeat the announcement I made this morning. We will accept as many statements as we possibly can until 5 o'clock. If we can't complete all of them by that time, we will recess and reconvene at the same place at 9:30 tomorrow. That, of course, will depend upon the length of the statements and the number of people who wish to comment.

Again, I want to emphasize that our reason for being here is to hear all pertinent information. No one is going to be cut short or cut off as long as he has anything relevant to say, the statements are germane and not repetitious. But recognizing the fact we have physical limitations with a certain human frailty, we can do just so much in one day.

Mr. Harris, please continue. You may continue until 5 o'clock.

STATE PRESENTATION (Continued)

MR. HARRIS: As the first speaker after the recess, I should like to call on Mr. Donald J. Benson, Executive Secretary of the Northwest Pulp & Paper Association.

PULP AND PAPER INDUSTRY PRESENTATION

STATEMENT OF DONALD J. BENSON
EXECUTIVE SECRETARY
NORTHWEST PULP & PAPER ASSOCIATION

MR. BENSON: Conferees, Mr. Stein, Mr. Poston, Mr. Harris.

My name is Donald J. Benson. I am Executive Secretary of the Northwest Pulp & Paper Association. This non-profit corporation was founded in 1957 by the pulp and paper industry of Oregon and Washington to conduct technical investigations, to sponsor research and to prepare information regarding air and water quality control for this industry.

We have followed the FWPCA survey of Puget Sound waters of 1962-1966 and have reviewed the resulting report, "Pollutional Effects of Pulp and Paper Mill Wastes in Puget Sound", dated March 1967. We solicited advice and counsel in this review from professional experts of various talents, both from within the industry and from those outside the industry. These consultants have all practiced in the Pacific Northwest and several are nationally known for work in their fields.

Upon reviewing the information presented in the FWPCA report and the results of research conducted by other workers, we arrive at conclusions very different about the effects of pulp mill waste discharges in Puget Sound from those of the Federal study group.

Although many of the basic field data presented in the report are useful, questionable laboratory experiments and inadequate analyses of the data lead to some serious errors in conclusions. A number of interesting hypotheses are developed in the Federal report, but these are not followed up with adequate facts upon which to base conclusions. In our testimony today we will discuss the methodology of investigation, the interpretation of the data and suggest explanations for the conflicts between the reported conclusions and observable field conditions.

We believe that this testimony will show that the present levels of spent sulfite liquor in outer bays and harbors are not harmful to any other legitimate water uses and that the use of the Pearl-Benson Index near the levels of minimum detectability is not a proper and scientifically valid use of the test.

DONALD J. BENSON

A great deal of time and effort of the Puget Sound survey was spent in establishing a relationship between artificially spawned oyster larvae and spent liquor as measured by the Pearl-Benson Index.

It has been known for a number of years that in the first few hours of embryonic development, oyster larvae are affected by spent sulfite liquor, but this is not important because nowhere in Puget Sound does spent sulfite liquor come in contact with oyster larvae. This is because the temperatures of the northern portions of the Sound are generally too low for natural oyster spawning and setting. Wild oysters are found in North Puget Sound in very limited areas and the commercial beds in the Bellingham-Anacortes area must rely upon purchased oyster spat brought in from other areas, because low temperatures inhibit natural sets.

The use of bioassay results on oyster larvae, a form not even present in the waters in question, cannot be accepted as an indication that damage occurs to other forms of marine life which are present in obviously great and healthy quantities.

While we continue to believe that relating bioassay results to the nonexistent oyster larvae is a non sequitur, we must question the method of establishing the levels at which the laboratory-spawned larvae exhibited a response to spent sulfite liquor.

The test procedure for the oyster larval bioassay is not considered adequate for establishing finite levels of field conditions. It has been the experience of many scientists using bioassay techniques that small scale laboratory experiments are more critical to living forms than similar conditions found in the environment.

Professor Wilbur Breese of the Yaquina Bay Laboratory at the Oregon State University found that by increasing the temperature of the oyster larval bioassay to a level more nearly suited to natural spawning and egg development conditions, the response to spent sulfite liquor levels was reduced significantly. At normal temperatures only one-half to one-third of the response was observed. This may indicate that the oyster larvae under the test condition reported by the FWPCA were being so stressed that any slight additional stress of a foreign substance such as SSL was enough to indicate a very sensitive response.

The Pearl-Benson Index is at best an approximate indicator of levels of spent sulfite liquor and is not at all satisfactory at the lower levels of sensitivity. The test indicates the presence of materials having chemical structures resembling lignin whether emanating from a pulp mill or other sources either man-made or natural. For example, the apparent PBI response in Lake Washington where there are no pulp mills frequently exceeds 10 parts per million.

Dr. J. L. McCarthy, who has been the principal investigator of the pulp mill research group at the University of Washington since its inception in 1944, will comment briefly on the Pearl-Benson test later in this Conference.

The test tube response of spent sulfite liquor to the Pearl-Benson Index test will persist long after many of the materials which may have originally been associated with the lignin portions are degraded. Observations verifying this persistence have been documented and reported in the 1960 Gunter-McKee Report. This same relationship has been shown to hold for other pulping process effluents. Therefore the use of the PBI test for biologically related effects is severely limited by a lack of specificity. Mr. Eugene P. Haydu, a research biologist employed by the Weyerhaeuser Company, has just completed an assignment to the National Technical Advisory Committee on Aquatic and Animal Life. This committee appointed by Secretary of the Interior Udall was charged with establishing guideline criteria for judging water quality standards of the states. Mr. Haydu will discuss the deliberations of this expert committee on this matter later in this Conference.

The FWPCA report contention that the response of larval oysters is indicative of the response of many other forms found in the bays can be evaluated by only one project on a form indigenous to Northern Puget Sound waters, the English sole egg. Here again further work shows that the test conditions, particularly the use of poor, artifically spawned eggs,were a primary factor in the response to spent sulfite liquor. In addition, field observations do not substantiate the FWPCA laboratory findings. For example, it is important to note that Port Gardner is the primary producer of English sole for the Puget Sound market and shows no signs of a diminishing supply.

Dr. T. Saunders English, who is recognized for his research on English sole, will describe his work later today. His results conclusively refute the contention that the English sole egg is affected by levels of SSL found in the outer bays. This also destroys the thesis that the larval oyster bioassay can be used to predict the response of another species or form of marine organisms.

In other studies the FWPCA report attempts to establish a correlation between various parameters of adult and juvenile oysters and distance from the mill outfall.

Only the Bellingham area was included in these studies. The FWPCA report claims an adverse reaction at Station A, less than three miles from the outfall. The South Bellingham-Samish Bay area, where oysters are cultivated, is 10 to 12 miles from the outfall and is situated outside of the general pattern of waste distribution. The following observations raise serious questions regarding the FWPCA report.

1. Station A lies in the path of the Nooksack River discharge where effects of reduced salinity may have produced the results noted. The mortality rate at A was about 15 percent against about 4 percent to 8 percent at the other stations. A mortality of 10 percent is not unusual on producing beds.

2. An analysis of the data collected at the remaining stations shows that the FWPCA hypothesis of mortality increasing toward the mill is not substantiated.

3. Water quality data was collected only once each month. Even these infrequent samplings revealed

a salinity range at Station A from 6 to 29.6 parts per thousand. The lower ranges may have resulted in the poor oyster response with prolonged exposure. One week of exposure below 10 to 13 parts per thousand has been demonstrated by other investigators to cause adverse effects upon both survival and condition factor of oysters.

4. The FWPCA data of oyster growth studies show that, except for Station A, growth was generally greater at stations with higher levels of SSL. Interestingly these data were considered invalid and were ignored in the FWPCA analysis.

5. An analysis of the data supplied for Stations B through G shows no correlation between distance from mill or SSL to condition factor and mortality in Bellingham Bay.

An additional study described in the FWPCA report is used to conclude that the SSL concentrations are inimical to plankton activity in Port Gardner and Bellingham Bay. Port Angeles plankton data were not reported.

The report states that nearly equal numbers and varieties of plankton are found throughout both Bellingham Bay and Port Gardner. This ovservation holds even for the several stations very near to mill outfalls.

The conclusions that planktonic activity is reduced near these outfalls is not supported by previous work where other methods for observing these phenomena were used

The methods and analyses used for reaching conclusions about the effect of the mills on phytoplankton activity are open to serious question. The available information about Puget Sound in general and Port Gardner in particular does not lead to a conclusion that concentrations of spent sulfite liquor cause a meaningful problem for planktonic activity. Mr. Charles S. Yentsch of the Woods Hole Oceanographic Institute, an internationally recognized specialist on biological oceanography, particularly in the areas of phytoplankton, chlorophyll and productivity, will discuss this later in this conference. Mr. Yentsch studied at the University of Washington and also published original research on phytoplankton in Puget Sound.

It is our position that the foregoing comments and questions, supported by the expert testimony to follow regarding the studies of oyster larvae and English sole egg bioassay, adult oysters and plankton activity, refute the conclusions of the FWPCA report regarding spent sulfite liquor standards.

DONALD J. BENSON

Therefore, the requirement of spent liquor solid recovery as suggested by the report is unwarranted. Levels of spent sulfite liquor in Puget Sound are not harmful to other uses and users of the waters. It is the conclusion of the industry that an expenditure in excess of 40 million dollars required for installations essential to such recovery is not justified for the inconsequential benefits that might be derived. Further, the cost of evaporation and burning of spent sulfite liquor would be increased substantially because of air pollution control requirements expected due to the locations of all of the mills in question. In certain cases substantial improvements of inner bay water quality may be achieved either by the removal of settleable solids or better outfall location at costs much more commensurate with expected results.

We have one final comment regarding the FWPCA report. Tests were run on fingerling salmon holding them in live boxes very close to the mills and waterfront docks under particularly unfavorable circumstances of wind and tide. The fish in some of these boxes were affected, apparently,by toxic materials occasionally released by sludge beds close to the municipal waterfronts. The report offers no evidence that such troubles beset naturally migrating fingerlings except in rare instances when they might be present in these areas at unfavorable times. Studies by the University of Washington Fisheries Research Institute of fish migration patterns and successes in the Everett area lead them to the conclusion that mill operations do not appreciably affect the fishery. Dr. Ernest Salo, Associate Professor with the Institute, will discuss these studies later in the conference.

Dr. Katz will give us his thoughts on the salmon and steelhead fisheries production of Puget Sound later. He notes that the Nooksack River, which flows into Bellingham Bay, is one of the few Puget Sound streams showing a consistent and substantial increase in the production of chinook salmon.

The explanation for the apparent contradiction between the field studies on salmon and the conclusion of the FWPCA report are:

1. The restricted areas and limited times that any water conditions are adverse to fish, and

2. The relatively few natural migrants that are found in these areas at such times.

We suggest that the removal of any existing sludge deposits be thoroughly studied before such a difficult and costly task is undertaken.

DONALD J. BENSON

We appreciate this opportunity to present our views on the Federal report. The study was a monumental undertaking and supplies much additional information on Puget Sound. We do not wish to detract from the usefulness of the field data portion included in the report, but we do feel obligated to point out that the analysis of the information collected by the Federal scientists is open to various other interpretations by equally dedicated and talented engineers and scientists working in this field.

In addition we respectfully ask for one other consideration. Because of the very technical nature of this testimony presented in these proceedings we request that the record be held open for a period of two weeks to allow the Conferees time to adequately review the scientific testimony and permit the submission of additional comments and reference material. We suggest, for instance, that the proceedings of the Water Quality Standard Service at Mount Vernon and at Port Angeles be included in this record.

Thank you.

(The hearings referred to are marked Exhibit 3 and are on file at the FWPCA Headquarters in Washington, D.C., with copies on file at the FWPCA Regional Office in Portland, Oregon, and the State of Washington WPCC office in Olympia, Washington.)

CHAIRMAN STEIN: Thank you, Mr. Benson. Why don't you wait a minute now?

Are there any comments or questions?

MR. HARRIS: I have none at this time.

CHAIRMAN STEIN: Mr. Poston?

MR. POSTON: I have none.

CHAIRMAN STEIN: Mr. Benson, you asked first that the record be held open for a period of two weeks.

MR. BENSON: Yes, sir.

CHAIRMAN STEIN: Do you represent all the mills named in the report?

MR. BENSON: All but one.

CHAIRMAN STEIN: Which one is that?

MR. BENSON: Rayonier.

CHAIRMAN STEIN: Do you know if they join with you in this request?

MR. BENSON: I do not know.

MR. PERKINS: We join in that request. My name is De Forest Perkins. I am attorney for Rayonier.

CHAIRMAN STEIN: Now, let's see if I understand, as I can get here, the areas of agreement.

As I understand your statement here, the question of removing the solids and improving the outfall lines so you get maximum diffusion, you are in agreement that this should be done?

MR. BENSON: In some cases, yes.

CHAIRMAN STEIN: Pardon?

MR. BENSON: In some cases, yes.

CHAIRMAN STEIN: How about the methods indicated in the Federal report, these questions of what they call primary treatment, removal of the solids and the diffuser lines as indicated by the State of Washington? I don't think there is any difference or substantial difference between the State and the Federal people on this, as I understood their statements. Do I take it that you concur with them in this?

MR. BENSON: I would really prefer the individual mills to answer this, because there are some nuances here that I think they would be better able to describe in their statements later. Would this be all right?

CHAIRMAN STEIN: That is fine. You know, this is a conference.

The purpose of my inquiry is to narrow the issues as much as possible. In other words, if we can find a substantial area of agreement on what is required for removing of settleable solids and diffuser lines, then we may have just two areas of possible difference of views and that may be the question of a reduction in the strength of the sulfite waste liquor and the removal of the sludge beds.

In reading your statement, I am not sure that we may not be approaching an area of agreement in the primary treatment operation and the diffuser line operation.

MR. BENSON: I think this will become more evident in particular when the individual mills make their statements.

CHAIRMAN STEIN: Right. Are you going to have both the scientific experts and the individual mills make their statements?

MR. BENSON: Yes, we will have--

CHAIRMAN STEIN: There will be two different approaches?

Let me make one other comment for the record. As I read this, and as you read this, I read it along with you, there are a lot of conclusions here, pretty flat statements.

MR. BENSON: Yes. I would hope to have these backed up substantially with the expert witnesses to follow.

CHAIRMAN STEIN: There was one point that I was struck with in the Federal investigation--and again this is a case where we want to join the issues--one, that they didn't just take the measure of the sulfite waste liquor itself--as you indicate, and as I think one of the Federal investigators indicated, there may be defects in this test--by itself, but they did this in correlation to oyster mortality. Presumably they found a rather close correlation. When you take these two factors together, the fermentations and combinations suggest a relationship. I don't know whether you feel this, and this is up to you, whether you handle one or the other.

The second point is that, as far as I could see in the Federal report, there was a corresponding decrease in the sulfite waste concentration during the period of the strike as measured by the Pearl-Benson Index, again in direct correlation to the non-defects in the oyster larvae.

Again I am trying to get the issue lined up. This isn't a question, as I see it, of just taking each single part of that and saying one is bad and the other is bad. What the Federal report has purported to do is to put them both together, and the explanation of the relationship of the correlation to that is something, I think, that we have to consider and meet.

MR. BENSON: I think that as our story unfolds with the expert witnesses, some of this will become more apparent.

CHAIRMAN STEIN: Right.

Any further questions or comments?

MR. HARRIS: I have no comments.

CHAIRMAN STEIN: All right.

Thank you very much, Mr. Benson.

MR. HARRIS: The next group of participants will be the people named by Mr. Benson's report in the order in which they were named.

Next would be Professor Joseph McCarthy.

STATEMENT OF JOSEPH L. McCARTHY
PROFESSOR IN CHEMICAL ENGINEERING
UNIVERSITY OF WASHINGTON

PROFESSOR McCARTHY: Mr. Stein, Mr. Poston and Mr. Harris, ladies and gentlemen.

My name is Joseph McCarthy. I am a Professor in Chemical Engineering at the University of Washington, and for about the last two decades I have served as the principal investigator of the Pulp Mills Research Project which has been conducted at the University of Washington under the sponsorship of the Northwest Pulp and Paper Association.

I wish to comment today on the results of investigations which have been conducted as part of this program, that is particularly investigations which have been carried out on the Pearl-Benson or nitroso method for the estimation of sulfite spent liquor concentration in fresh and salt waters, a procedure which I believe, incidentally, was introduced and first used by Professor

Benson and Dr. Pearl at the University of Washington in 1940. The results of our investigations in this field have been published in the TAPPI magazine in 1963 as three papers, and copies of these are attached to this statement. I hope they may be made part of the record.

CHAIRMAN STEIN: These will be, with your approval, included as exhibits in the record. They will be available in the offices of the Federal Water Pollution Control Administration in Washington, D.C., and Portland, and in the State. This is one of the documents which is published in a publication found in most scientific libraries and is readily available, so I think we can handle it as an exhibit.

(The papers referred to are marked Exhibit 4 and are on file at the FWPCA Headquarters in Washington,D.C., with copies on file at the FWPCA Regional Office in Portland, Oregon, and the State of Washington WPCC office in Olympia, Washington.)

PROFESSOR McCARTHY: Very good. Thank you.

A further related investigation is still in progress and this will also be described a little later.

More specifically, the initial investigations, conducted by Mr. V. F. Felicetta and me, were published under the title "Spent Sulfite Liquor, Paper X, the Pearl-Benson, or Nitroso, Method for the Estimation of Spent Sulfite Liquor Concentration in Water", (TAPPI 46, 337-347 (1963). The first two conclusions presented from this work were the following, and I quote from the published paper:

"1. For estimation of the concentration of the spent liquors from sulfite pulp mills in fresh and salt waters, the Pearl-Benson method based upon a nitroso lignin color reaction is in common use in the Pacific Northwest region of the United States.

"2. In an initial survey, estimations of spent sulfite liquor concentrations in five water samples by the Pearl-Benson method conducted in 19 Pacific Northwest laboratories yielded results which varied substantially for the respective samples and this variation was apparently caused largely by use in the several laboratories of somewhat different procedures for conducting the analyses."

After conducting this initial survey, Mr. Felicetta and I, along with eight other collaborators, developed, agreed upon and published the description of an improved procedure under the title "A standarized Pearl-Benson, or Nitroso, Method Recommended for Estimation of Spent Sulfite Liquor or Sulfite Waste Liquor in Concentration in Waters", which was published in TAPPI magazine, Volume 46, No. 6, June 1963. Collaborators and co-authors, along with Mr. Felicetta and with me, in this work were the following persons: Professor C. A. Barnes and Dr. E. E. Collias, the Department of Oceanography, University of Washington, Seattle; Dr. Otto Goldschmid, Rayonier, Inc., Shelton, Washington; Dr. B. F. Hrutfiord, Pulp Mills Research Program, University of Washington, Seattle; Mr. A. Livingston, Washington State Pollution Commission, Olympia; Mr. G. L. Toombs, Oregon Sanitary Authority, Portland; M. Waldichuk, Fisheries Research Board of Canada, Naniamo, British Columbia; Mr. Ron Westley, Washington State Department of Fisheries, Quilcene.

These gentlemen were the co-authors of this paper on standarized procedure. It was this procedure to which reference was made in our third conclusion:

"3. Careful study of the several available analytical procedures, and consideration and experimental investigation of alternative possibilities by the authors and by collaborating scientists, led to the selection of what is hoped to be a generally acceptable standardized method."

This standarized Pearl-Benson method was estimated by us to give a precision of the order of .5 to .6 parts per million of apparent spent sulfite liquor on a 10 percent solids basis when carried out in a particular laboratory. However, when the procedure was applied to a number of water samples in several different laboratories to permit estimation of reproducibility under these conditions, the conclusion was as follows:

"4. Estimations in 16 separate laboratories of spent sulfite liquor concentrations in five sample waters using substantially the procedure of the standardized method yielded results showing standard deviations in net absorbances of about plus or minus 0.007 to 0.014 equivalent to about plus or minus 3 to 6 parts per million of spent sulfite liquor containing 10 percent total solids."

Our fifth and last conclusion in part was as follows:

"Although this standardized Pearl-Benson or nitroso method for estimation of spent sulfite liquor concentration gives satisfactorily reproducible results and is relatively simple to carry out, the nitroso procedure may lead to erroneously high results when interfering substances are present."

To illustrate this phenomena, the following paragraph is quoted from Page 344 of our published paper:

"Waters I, IV, VIII, and X were salt, fresh, fresh, and salt water samples, respectively, from the Pacific Ocean, Lake Washington, Quilceda Creek, and Deception Pass, respectively, into which no spent sulfite liquor is discharged and no spent liquor was added to the samples. However, about 2, 8, 1 and 3 parts per million of apparent spent sulfite liquor concentrations, respectively, were found in these samples by PMR Laboratory M using procedures similar to those of the standarized method (10), thus illustrating the influence of the presence of interfering substances."

Thus the Pearl-Benson nitroso method is based on a common reaction for certain ortho-, meta- and para- substituted phenols and other substances, as has been discussed in some detail by E. F. Mohler and L. N. Jacob in Analytical Chemistry magazine 29, 1369, 1957, and by others. Interference may arise from such substances as certain phenols as those from or in tannins, analine, xylidine, indole, urine, unhydrolyzed and hydrolzyed fish meal, and other substances.

From these observations I conclude that the Pearl-Benson method is a moderately sensitive and reproducible procedure, but one which suffers from some shortcomings of non-specificity; that is, the Pearl-Benson reaction takes place not only **with** lignin sulfonates but also with other substances, which contain a molecular structure or a molecular configuration similar to the configuration or configurations present in lignin sulfonates which give rise to the Pearl-Benson reactions.

In view of this imperfect specificity of the Pearl-Benson method, several years ago as part of the

Northwest Pulp and Paper Association sponsorship of an investigation program we initiated research in what I shall call the vanillin method for conducting the unique determination of spent sulfite lignin concentration. A preliminary report on this procedure was published by Mr. Felicetta and me under the title "Spent Sulfite Liquor XI Preliminary State of the Possibly Unique Determination of Lignin Sulfonates in Water" published in the TAPPI magazine 46, 1963.

Further work on this method is now in progress in collaboration with Dr. Bjorn Hrutfiord at the University of Washington with the assistance of a grant of funds in the amount of $47,896 over a three-year period from the Research and Training Grants Program of the Federal Water Pollution Control Administration, Department of Interior.

At present it appears that this vanillin method can now be carried out successfully to estimate uniquely the concentration of spent sulfite liquor in fresh waters, and we are hopeful that a somewhat modified procedure can soon be specified which will give satisfactory results in salt waters.

Thank you for the opportunity to make this statement. I shall be glad to try to answer any questions which occur to you.

Thank you.

Before I cease, may I just make one correction? In the text on Page 3 there was clearly an error, as you heard me pause, and it has got to do with the title of that paper. It is on the bottom of Page 3, the next line to the bottom, in place of the word "state", s-t-a-t-e, the word should be "study", s-t-u-d-y. I am sorry.

CHAIRMAN STEIN: "Preliminary study"?

PROFESSOR McCARTHY: Yes.

CHAIRMAN STEIN: Thank you.

Thank you very much, Mr. McCarthy. Are there any comments or questions?

MR. POSTON: I have a question.

CHAIRMAN STEIN: Yes.

MR. POSTON: You stated that the PBI measures spent sulfite liquor. Are there times when it doesn't measure?

PROFESSOR McCARTHY: I think so. When some of the substances which interfere are present.

MR. POSTON: Then you would get a negative result?

PROFESSOR McCARTHY: Oh, I think not. When we get an erroneously high result.

MR. POSTON: That answers my question.

CHAIRMAN STEIN: As I understand your statement, Professor McCarthy, the vanillin method that you have developed to measure sulfite waste liquor is available for fresh waters, but it is not perfected yet for salt waters. In other words, your method is not available for the waters that were tested here in the survey?

PROFESSOR McCARTHY: Not in really satisfactory manner. The preliminary paper we published in 1963 does give some results, I believe, on salt water samples, but we have had trouble with salt crystalizing out.

CHAIRMAN STEIN: Right.

PROFESSOR McCARTHY: And we can't quite do it yet, but I think we are quite close to the solution of that problem.

CHAIRMAN STEIN: But the point is, you say, "we are hopeful that a somewhat modified procedure can soon be specified which will give satisfactory results in salt waters." In other words, your method is not available, couldn't have been available for these people to use with reliability in salt waters now?

PROFESSOR McCARTHY: That is correct.

CHAIRMAN STEIN: You also raised the point that you may get into interference in using the Pearl-Benson nitroso method, which presumably the Federal and State joint investigators used and have been using, interference which arise from such substances as phenols, tannins, analine, and so forth. You heard the report this morning, didn't you, Professor?

PROFESSOR McCARTHY: Yes.

CHAIRMAN STEIN: The point is, I think it was stated by the investigator that when the mills shut down the Pearl-Benson Index was zero or close to zero, and, at least the way I understood, that it appeared that either none was there or none of these other substances was around to create interferences. The only conclusion that you possibly may get is when the mills are in operation, either it is measuring sulfite spent liquor or the mills are putting out these substances which are creating interferences.

If this is the case, and there is a correlation with what the mills are putting out and the effect on the oysters, what is the difference?

PROFESSOR McCARTHY: I guess I don't really understand your question. (Laughter)

CHAIRMAN STEIN: All right. Maybe it is a rhetorical question. I am not asking you to understand it. I am trying to understand the point. The record will be open for two weeks, I hope.

PROFESSOR McCARTHY: I would be happy to try to reply to your question, but I sincerely really didn't understand what you asked me.

CHAIRMAN STEIN: The point is, if they found zero in these, then there were no interfering substances.

PROFESSOR McCARTHY: At that time and place, I think that is correct.

CHAIRMAN STEIN: Right. But they did find readings when the mills were in operation. Now, there can be two theories. One, naturally at that time and place when the mills are shut down there were no interfering substances. When the mills were in operation either they were--maybe there were three theories and the third might be either they were measuring spent sulfite liquor or they were measuring one of these interfering agents which may have been produced by the mill or maybe when they were measuring at all times when the mills were in operation somehow the interfering substances came into that area naturally. The last seems unlikely.

Now, if they found the correlation with the reading they got on the Pearl-Benson Index, whether this was the interfering substance or the spent sulfite liquor or whatever it was, and they related it to the mills in operation and the effect on the oysters, isn't that the point they were trying to prove? In other words, what is the point of the interference issue when the Federal-State report indicated when the mills were not in operation evidently there weren't these interfering elements there and they got zero or close to zero on Pearl-Benson?

PROFESSOR McCARTHY: If the method was carried out approximately in accordance with the description that we made, I think our conclusion is that what is measured is approximately the concentration of sulfite spent liquor, provided that such interfering substances are not present and within the precisions that I recited to you.

CHAIRMAN STEIN: Right.

PROFESSOR McCARTHY: But it is a fact, though, that interfering substances do occur, as you well know--

CHAIRMAN STEIN: I don't think there is any disagreement. As I understand the situation, when you measure these, use the Pearl-Benson Index in certain waters where you know sulfite waste liquors are not present, you get certain reactions.

PROFESSOR McCARTHY: Surely.

CHAIRMAN STEIN: However, they did measure them here when the plants were closed and you knew they weren't there and the answer was close to zero. Then when they measured it when the plants were in operation they got a reading. Under that I am asking again--I am not asking for your conclusion, but at least the indication seems to come up that in that case where they didn't find the interfering substances in those locations at the time when the mills were closed, there may have been the indication that they found sulfite waste liquor on the Pearl-Benson Index when the mills were open and not the interfering substances.

PROFESSOR McCARTHY: Well, our conclusion, of course, in this whole study is that the method is a moderately good reproducible one, but subject to these limitations.

CHAIRMAN STEIN: Right. Thank you very much.

MR. HARRIS: Thank you, Dr. McCarthy.

PROFESSOR McCARTHY: Thank you.

MR. HARRIS: The next expert on Mr. Benson's panel is Mr. Haydu.

STATEMENT OF EUGENE P. HAYDU
WATER RESOURCES AND MANAGEMENT SECTION
WEYERHAEUSER COMPANY'S PULP RESEARCH DEPARTMENT

MR. HAYDU: My name is Eugene Haydu. I am group leader of the Water Resources and Management Section of Weyerhaeuser Company's Pulp Research Department at Longview, Washington.

Ladies and gentlemen, I have a stutter, most of you know this but some of you may not, and I ask for your kind patience while I read this statement.

I have a few comments to make about several aspects of the FWPCA report. I assume that by now most of you are familiar with these abbreviations, PBI, SWL, FWPCA. My initial comments will deal with the Pearl-Benson test, its adequacies and inadequacies as a realistic measure of sulfite waste liquor in receiving waters. I am not here concerned with the specificity of the PBI test, that is, whether or not it measures only sulfite waste liquor. The limitations of the test in this respect are well recognized.

The terms PBI and sulfite waste liquor are too frequently used interchangeably. This practice is misleading and erroneous. The organic fraction of sulfite waste liquor, like kraft wastes, consists of a great variety of organic compounds ranging from those which rapidly decompose to those which degrade very slowly. The lignins are the major organic components of kraft and sulfite waste liquors. They are also quite stable, that is slow to decompose. Due to their stability and to the fact that they occur in high concentrations, the lignins constitute an appropriate substance for tracing in receiving waters and for chemical analysis.

The PBI test has been developed to determine concentrations of lignin and related compounds as a measure of SWL. It is important to note that the test measures only the stable lignins and related compounds in SWL. It does not measure a substantial portion of SWL which is degradable. Since PBI measures only some of the compounds in SWL, it is not a measure of total SWL and, therefore, the two terms cannot and should not be used interchangeably.

The toxicological and other physical and chemical characteristics of pulp mill effluents, including SWL, have been found to vary considerably during any given day in any given plant due to changes in pulp grades, species and sources of wood, and so forth. Considerable variation in effluent characteristics occurs even with a given pulp mill using similar cooking conditions. In view of the great complexity and variability of the characteristics of pulp mill wastes, it has been very difficult to find a satisfactory expression for concentration. For example, attempts have been made to relate toxicity to various dilutions of waste and to BOD, COD, total solids, PBI and various reference animals. None have yet proven to be very satisfactory.

Recent studies have shown that a substantial portion of pulp mill wastes, including the toxic components, are very susceptible to microbial degradation and destruction. In one study kraft mill wastes were found to be nontoxic to oysters at a dilution of 1 to 20 when the BOD of the wastes were reduced by 80 percent. In another study, the toxicity of kraft waste to silver salmon was found to diminish in approximate proportion to the degree of BOD reduction.

Results of the most recent investigations by scientists of the International Pacific Salmon Commission indicate a fairly close relationship between the degree of BOD reduction and decrease in the toxicity of kraft wastes. They found no apparent toxicity to salmon when the BOD was reduced by 65 percent. While similar studies have not been made with sulfite liquor, the available evidence indicates that the toxic components of this waste are also degradable. The toxicity of fresh sulfite waste liquor at a PBI concentration of 50 ppm would be much greater, therefore, than of biodegraded sulfite waste liquor at the same PBI concentration.

The composition and the toxic characteristics of sulfite waste liquor in receiving waters would vary, therefore, with time and distance from the point of discharge even though similar PBI values may occur. In view of this, and because of the great variability in the characteristics of sulfite waste liquor, the setting of PBI standards would be improper and unrealistic.

The setting of such PBI standards was suggested to the National Technical Advisory Committee on fish, other aquatic life and wildlife. The subject was duly considered and discussed and the consensus of the committee was to not include PBI in their recommendations on the water quality requirements of fish, other aquatic life and wildlife.

CHAIRMAN STEIN: Do you want to take comments on both these statements at the same time?

MR. HAYDU: Well, sir, I had no way to know what to expect, and so I prepared these--

CHAIRMAN STEIN: Why don't you go through your second one? Is the second one related somewhat?

MR. HAYDU: I think they are related, so I might as well complete this other.

CHAIRMAN STEIN: Certainly.

MR. HAYDU: I might add that I am having some speech therapy, and of course this is old hat to most of you and I hate to impose myself upon you, but to me it is extremely important. Oddly enough, to overcome stuttering I have to stutter. Well, here I am not making an effort. I am. (Laughter)

They have some rather neat little techniques, you know, that are supposed to help as you become more refined in this thing. One is what they call the slide technique. When you reach a word that you can't say, like for me b's and d's are a horror, you are supposed to kind of slide into it, you know, like a ball, and,gee, I haven't gotten around to that yet. (Laughter)

Another little technique is what they call the bounce, b-b-b-bounce. So if I use some of these techniques, why, just kind of ride along, folks. Thank you.

I should also like to comment on the oyster larval tests, how well these people can prognosticate, and their use in the FWPCA report. In considering these oyster larval tests, it is important to distinguish between the validity of the test,per se, and the validity of generally applying results so derived to other species of aquatic life, even to closely related forms. I am here less concerned with the test as such than with the applications suggested in the report.

The results of the tests with oyster larvae as described in the report show that the normal embryonic development of these larvae are adversely affected by even very low concentrations of SWL. The report goes on to suggest that other forms of aquatic life, some of which are closely related, others not so closely related, are similarly affected. The report does not provide data to support this suggestion, however. It has been proposed that due to its sensitivity and reproducibility the oyster larval test be adopted as a standard test for establishing the toxic levels of all suspect pollutants. Such a proposal ignores the general experience of biologists of the great diversity in the sensitivity of various species to environmental change, whether natural or induced. An example of this can be shown by the range of 48-hour median tolerance limit values found for an organophosphorus insecticide.

For shrimp, the median tolerance limit value was 0.0002 parts per million. For fish it was 0.01 parts per million. And for the oyster it was 0.3 parts per million. This represents a one thousand five hundred-fold difference in the response of three different species to the same material.

In long-term laboratory studies of the oyster-mud flat community which I carried out during the 1950's, the productivity of clams from the larval stage was 2 to 6 times greater in the presence of SWL than in the controls. The concentration of SWL in the tests was 3 to 5 times greater than those indicated to be harmful to oyster larvae in the FWPCA report.

As already mentioned, I am at this particular time less concerned with the oyster larval test as such than with its possible applications. Actually, the concept and use of reference animals is by no means new. Such tests, with very sensitive species or life stages thereof, have proven to be especially useful in screening tests; for example, in establishing the relative toxicities of various substances. Reference animals are also commonly employed to determine preliminarily harmful and beneficial dosages of drugs for human use. The use of animals for these purposes is selective; that is, to those species which most nearly react in the same manner as humans. Indicative as these preliminary tests may be, final conclusions are ultimately based on similar tests made with appropriate samples of the human population.

It may be instructive at this point to refer to the thoughts and suggestions of the National Technical Advisory Committee on Fish, Other Aquatic Life and Wildlife on this matter. After considerable deliberation, the committee suggested certain basic guidelines in their rationale concerned with determining toxicity by the bioassay technique. Among those most pertinent to this discussion mention should be made of the following:

1. "Fish too often are considered as a single species (like rats or people) instead of a multitude of species, many again distinctly and greatly different from other related species. Because of the important species, essential food organisms and water quality will be different in different habitats, a single value or concentration has very little applicability unless appropriate margins of safety are incorporated."

2. "Test organisms should be selected on the basis of their economic importance in the area receiving the discharge and their sensitivity or on the basis of their importance in the food web of economically important animals. In the event that organisms meeting these criteria are not suitable or available for the confined conditions of the tests, then substitute animals endemic to the area may be utilized. Appropriate tests must be undertaken to demonstrate the relative sensitivity of economically important species and substitute species to the test material so that meaningful interpretations of the data can be made."

For the most part, these guideline commentaries are self-explanatory. It will be noted, however, that emphasis is given to economically important species in the area and to indigenous forms. It is also indicated that if substitute animals are used, their relative sensitivities and those of economically important species must be established. Emphasis is also given to the diversity of species and their differing reaction to toxicants and hence to the unapplicability of using a single value or concentration that would be safe for all.

Applications of the oyster larval test as suggested in the FWPCA report are hardly valid under these considerations. As a matter of fact, such attempts are contrary to some of the basic recommendations cited above. In this context, it is difficult, for example, to see the relevancy of the oyster larval test to Port Gardner Bay in view of the fact that oysters are neither an economically important species in this area, nor are they indigenous. In fact, there are no oysters here. On the other hand, there are a number of economically important species in Port Gardner Bay which have been studied in the laboratory and in the field to determine the effects of sulfite waste liquor on their productivity. These results are directly applicable to the problem at hand and will be reported upon in some of the later statements.

There are other areas in Puget Sound where oysters are grown in the presence of the SWL. It is my understanding that while limited oyster spawning may occur occasionally in these areas, the industry must depend upon seed oysters brought in from other areas to sustain itself. Since the larval stage is of very limited significance in such cases, the oyster larval test can hardly be considered as relevant. It would be much more realistic to devote toxicity studies to the life stages and species which do occur there.

Thank you very much.

CHAIRMAN STEIN: Thank you, Dr. Haydu. Are there any questions or comments?

MR. HARRIS: I have no questions.

MR. POSTON: No questions.

CHAIRMAN STEIN: I would like to refer back to your first paper, largely your statements on Page 2. You talk about the toxicological characteristics of pulp mill effluents, including sulfite waste liquor. You also talk about the toxicity of kraft wastes and the available evidence--"While similar studies have not been made with sulfite liquors, the available evidence indicates that the toxic components of this waste are also degradable." Then in the last paragraph you stated:

"The composition and toxic characteristics of sulfite waste liquor in receiving waters would vary therefore..."

In other words, as I understand your view, Dr. Haydu, at certain points sulfite waste liquor does have toxic characteristics?

MR. HAYDU: It does, yes, sir. It does just like anything else does. For example, natural water.

This question was asked me by some other people, some lay people: Is there any poisonous pulp material in the waste? Of course there is, many, many.

You have many, many harmful materials in water. Some of these things are essential. However, if they occur in very high concentrations, why, they are harmful.

CHAIRMAN STEIN: How about their occurring at the point of origin? How about the concentrations of the toxic materials in sulfite waste liquor?

MR. HAYDU: You are asking me if the pure sulfite waste liquor is toxic before it has a chance to dilute with receiving water?

CHAIRMAN STEIN: Yes.

MR. HAYDU: Oh, certainly it would be.

CHAIRMAN STEIN: Yes. I think with that,

I am always hopeful and optimistic.

You know, I think maybe the State and Federal and the industry people are getting closer and closer together all the time, (laughter) because I have never heard an industry spokesman say that yet. This is a really good sign. It is just a question--

MR. HAYDU: I am not speaking for industry, sir; I am speaking for myself--

CHAIRMAN STEIN: Since the toxic material is degradable, considering the time and distance factor and seeing dilution in operation, as long as we are all agreed that we are starting out with a toxic material,I think we are a lot closer than we were before. This is one thing to be gained from these Conferences.

Thank you very much, Dr. Haydu.

MR. HARRIS: The next expert in Mr. Benson's group is Dr. English.

STATEMENT OF THOMAS SAUNDERS ENGLISH
ASSOCIATE PROFESSOR, DEPARTMENT OF OCEANOGRAPHY
UNIVERSITY OF WASHINGTON

MR. ENGLISH: Mr. Chairman and Conferees.

My name is Thomas Saunders English. I am an Associate Professor in the Department of Oceanography, University of Washington. I have been retained by the Everett Mills Technical Committee to inquire into some aspects of the biology of the waters of Port Gardner and to advise them of my findings and opinions. I am appearing today to report some of my observations.

I have conducted studies in Port Gardner, near Everett, Washington, since 1962. I have worked to assess populations of bottom fishes, especially the English sole. Reports of my work were submitted to the Washington State Pollution Control Commission in Mount Vernon, Washington, on 9 February 1967.

I have followed with interest the field and laboratory studies of my colleagues on the Federal Enforcement Project, now a part of the Federal Water Pollution Control Administration. I have been favorably impressed by their professional competence, by their vigor in attacking the many facets of the project, and by the substantial collection of data at their headquarters in Portland, Oregon. I am not favorably impressed with the anonymous report of March 1967 that uses the generally sound results of the scientists to reach what seem to me to be unsound conclusions.

The Federal report concludes that the English sole population in Port Gardner is subject to extensive damage. Personal observations and the reports of others lead me to a different conclusion. The reported results of my trawling research in Port Gardner, including catch records of the Washington State Department of Fisheries, show that the English sole fishery there is the best and most productive in Puget Sound. At the hearings in Mount Vernon I heard statements from the commercial trawlers who fish for a livelihood in Port Gardner. They reported that the fishing was very good and had never been better. Therefore, I am at a loss to understand how there can be extensive damage to the English sole in Port Gardner.

The conclusion in the Federal report about the English sole in Port Gardner, which I believe to be totally misleading, is a conjecture based on English sole egg bioassay studies. The studies were carried out by Dr. Harold Berkson of the FWPCA. They were extended by his colleague Marvin Allum. Their work involved holding artificially spawned eggs of the English sole in test solutions of sulfite waste liquor. The SWL was obtained from a mill and diluted over a range of concentrations as determined by PBI measurements. The results of Dr. Berkson show that very high concentrations of SWL can damage artificially spawned English sole eggs under the conditions of his experiments.

The Federal report suggests "a critical

threshold exists somewhere around 10 ppm SWL." The report notes that "damage induced at 10 ppm is not significantly increased by augmented concentrations of SWL until approximately 180 ppm SWL. Above this concentration, survival of exposed eggs is hopeless." The suggestion of a critical threshold at 10 ppm SWL is based on statistical treatment of the data. However, the figure which relates the percentage of eggs inhibited to concentrations of PBI reveals that "significant retardation does not occur until SWL concentrations exceed 180 ppm." The Federal report then recommends that the Everett mills "put into operation appropriate abatement measures to reduce SWL concentrations in the surface waters to less than 14 ppm." Therefore, the allowable level of SWL in Port Gardner is apparently related to the results of bioassay studies of the English sole egg.

Since the English sole population in Port Gardner seems to be in very good condition, I have had to wonder how the recommendation in the Federal Report came to differ so widely from my understanding of the situation. Several possibilities can be suggested.

1. The English sole eggs used in the bioassay were of poor quality or were subjected to undue stress.

2. The results of the bioassay were somehow

misinterpreted.

3. The PBI in Port Gardner is not as harmful as the SWL from a mill.

4. The results of a laboratory bioassay are not a useful guide to conditions in the ocean.

It is known that artificially spawned eggs differ from those released into the sea by a female English sole in nature. The natural eggs are more spherical, the shells are clearer and much harder to break. There are evidences that the eggs were subjected to considerable stress under the experimental conditions. About 30 percent of Dr. Berkson's control "...eggs failed to develop into normal fry within ((the)) normal incubation period." Perhaps, therefore, the eggs were of such low quality or the experimental conditions were so rigorous that the eggs were moribund and easily damaged.

It seems possible that the results of the bioassay were misinterpreted in some way. The level of SWL at which damage is meaningful even under experimental conditions appears to be between 180 and 420 ppm rather than near 10 ppm. On several occasions I have reared eggs from Port Gardner in order to separate the kinds of eggs present. If the water in which those eggs were taken and reared reflected the average SWL concentrations reported, the results of the bioassay would suggest that the eggs had little chance to survive. I have not been aware of any unexpected difficulty in rearing naturally spawned eggs captured in Port Gardner.

My third question was the relationship between PBI and SWL. I am told that PBI measures substances other than those which can be compared to the discharge of SWL from a mill. The conclusions of the Federal report might be wrong if the PBI measured in Port Gardner reflects a situation less harmful than similar levels of SWL in the laboratory bioassays.

Finally, I attempted to learn in a very crude way whether the results of the laboratory bioassay are a useful guide to conditions in the ocean. The questions I have outlined above led me to suspect that natural fish eggs taken from Port Gardner and held in water with high PBI taken from Port Gardner might survive better than the results of the laboratory bioassay seemed to suggest to the authors of the Federal report. We were unable to get water of high PBI and fish eggs at the same time, so we had to use dilutions of sulfite waste liquor obtained from a mill, in the manner of Dr. Berkson.

The simple experiment used 24 fish eggs. Three eggs were selected at random and placed into each of eight containers. One container held control sea water and the others held concentrations of SWL of about 7, 14, 28, 55, 110, 220, and 440 ppm. Two of the control eggs hatched. The larvae lived somewhere between 92 and 337 hours, then presumably died of starvation. Two eggs hatched from concentrations of 7, 14 , 28 and 55 ppm SWL. All of the eggs in 110 ppm SWL died. However, two eggs hatched in 220 ppm and two eggs hatched in 440 ppm. Those larvae lived from 192 to 236 hours. There can be many objections to this experiment, and I would probably agree with those objections, but I am now firmly convinced that the conclusion of the Federal report is wrong in some major way.

I now cannot agree that SWL concentrations in the surface waters of Port Gardner must be less than 14 ppm to "prevent additional damages and provide minimum protection of these organisms during their most sensitive life stages." The English sole population in Port Gardner does not appear to be suffering from concentrations of SWL.

In closing, I repeat that I believe the Federal report has reached unsound conclusions.

Thank you, Mr. Chairman.

CHAIRMAN STEIN: Thank you, Professor English.

Are there any comments or questions?

MR. HARRIS: I would like to ask one question. You say, you refer here to the anonymous report of March 1967. Do you mean the Federal Water Pollution Control Administration report?

MR. ENGLISH: You are correct, sir.

MR. HARRIS: Why did you use the word "anonymous"?

MR. ENGLISH: If I cited that report in the bibliography of a scientific paper, I would cite it as anonymous. There is no name of a scientist there that I recognize.

MR. HARRIS: Thank you.

CHAIRMAN STEIN: Thank you.

You know, this is a peculiar use of the word "anonymous". I was going to raise the same question. As a regulatory officer in the Government, this is one of the problems with which I have been faced. I guess all you fellows know that in a bureaucracy a unanimous report is accredited to the agencies at the bottom of the cover page. Furthermore, the report was delivered and introduced by Mr. Kari, who was the head of the investigating group.

I think the anonymity was disclosed by Dr. English's remark on "Dr. Berkson,extended by his colleague

Marvin Allum." I seem to recall Marvin Allum in his anonymous capacity, because the lights were out, was talking to those slides a good portion of the morning.

I don't want to dispute you, Doctor, or Professor, that "in the scientific bibliography sense", I don't want to dispute those words, but I do think that both the agencies--and I think on this I can speak for the State and us, because we worked in this together--have a practice of producing the people who are responsible for the reports. And as far as I know in the regulatory or legal sense we make no anonymous reports. As a matter of fact, we find it hard to get hearsay into court.

MR. ENGLISH: Well, if you opened the floor to me again I would say, then, I must most respectfully dispute you. If I have been told that we have the white hats and the black hats here today, then in the business I work in this is called the gray literature.

I have discussed this matter with the scientists who worked on this project and they disclaim responsibility for the statements in that report. Therefore, I consider it to be an anonymous report.

Many reports of a very closely parallel nature are subdivided into sections and the name of the scientist is used with his work. In other words, I understand from that name who did the work.

CHAIRMAN STEIN: Are there any further comments or questions?

We have discussed this with the Conferees. As per announcement this morning, it is past 5 o'clock and we will stand recessed until 9:30 tomorrow morning, when Mr. Harris will resume with his invitees.

(ADJOURNMENT)